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EDITORIAL

The Madras Agricultural Department: *Reorganization of Circles.* Orders for the reorganization of circles have recently been issued. The changes affect the administration of the propaganda activity of the Department. The number of circles have been reduced from eight to four and consequently four posts of Deputy Directors have been abolished. Three new posts of Assistant Directors have been created, increasing the cadre from ten to thirteen. With the provision of an agricultural demonstrator practically for every taluk, it became very necessary to have more Assistant Directors for efficient supervision and guidance. This has been achieved without any additional burden to the tax payer. Now an Assistant Director will be in charge of roughly two districts with about eighteen to twenty demonstrators under him. The jurisdiction of the Deputy Directors has been widened from three districts to six districts. Whether it will be possible for them to cope up with extra work is a point which time alone can answer. Their work has been lightened a bit by the transfer of some of the Agricultural Research Stations to the Assistant Directors of Agriculture. This will certainly enable the Assistant Directors to test their ideas on the research stations in the first instance. It is hoped that with the transfer of these stations, they will serve the respective tracts more fully. Frequent transfers of the Assistant Directors would to some extent affect the continuity of work on these stations; and we trust that suitable steps will be taken to avoid this tendency. In this connection attention may also be drawn to the possibility of utilizing larger areas on some of the farms for the production of improved seeds. Experiments which are not likely to immediately benefit the public can as well be left out, and more area can be devoted to the production of seed. Before laying down an experiment it would be desirable to estimate the additional cost of a treatment (manurial or cultural) that is proposed, so that in no case a treatment is included the cost of which cannot be recompensated through probable gain in yield.

Given a definite programme of work based on needs of the taluk, the concentration of attention on such items which can be readily translated into field practice, continuous endeavour by the Deputy and Assistant Directors to improve the technique of propaganda and whole-hearted support on the part of the public, the outlook for the agricultural improvement of the province is bright.

For the benefit of our readers, the revised territorial jurisdictions are reproduced.

Deputy Directors.	*Assistant Directors of Agriculture.*	
	Headquarters.	Jurisdiction.
I Circle with headquarters at Cocanada	1. Vizagapatam	Vizagapatam.
	2. Rajahmundry	East Godavary. West Godavary.
	3. Guntur	Kistna, Guntur, Kurnool (2 taluks of Cumbum and Markapur).
II Circle with headquarters at Cuddapah	4. Nellore	Nellore, Chittoor (3 taluks of Kalahasti, Puttur and Tiruttani).
	5. Cuddapah	Cuddapah, Kurnool (7 taluks).
	6. Bellary	Bellary, Anantapur.
	7. St. Thomas Mount	Chingleput, Chittoor (6 taluks), Madras District.
III Circle with headquarters at Trichinopoly	8. Cuddalore	Tanjore, South Arcot.
	9. Madura	Trichinopoly, Madura.
	10. Tinnevelly	Ramnad, Tinnevelly.
IV Circle with headquarters at Coimbatore	11. Vellore	Salem North Arcot.
	12. Coimbatore	Coimbatore, The Nilgiris.
	13. Tellicherry	Malabar, South Kanara.

STUDIES IN THE MILLET *PANICUM MILIACEUM*, Linn.

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Introduction. The botanical name of this millet *Panicum miliaceum* is derived from the old latin word *Milium* which means millet (Blatter 1935). In Russia this millet is known under the name proso. The common English names of this millet are Common Millet, Hog Millet and Broom Corn Millet. In India it has different names in different languages. In North India it goes under the names *Chehna, Chinwa, Bansi* and *Vari*. In South India *Variga* (Telugu) and *Panivaragu* (Tamil) are the most common names.

Origin and Distribution. This millet is widely distributed in the world It has been grown from very ancient times in India, Africa, Southern Europe, China and Japan. It is a recent introduction to North America. In India it is chiefly grown in the Punjab, the United and the Central Provinces, Bombay and Madras. The area that this millet occupies in the whole of India is not available. In the province of Madras its area could be computed to be in the neighbourhood of 500,000 acres. There are two zones in which the main areas of the crop are concentrated, namely the Guntur zone comprising Kistna, Guntur and Nellore districts with about 300,000 acres, and the Madura zone consisting of the districts of Madura, Ramnad and Tinnevelly, with an acreage of about 100,000. The rest of the acreage is distributed in small areas in the other districts of the presidency.

According to Komarov (1931) this millet is as ancient as wheat. Its origin is undoubtedly in the old world. Williams (1899) suggests an Egyptio – Arabian region as the home of this millet. Burkill (1935) states, "Vavilov (*Bull. Appl. Bot. and Plant-breeding*, 26, 1926, P. 180) calls attention to the way in which its rapid growth serves the nomads whose sojourn in one place is apt to be short, and he suggests that it was brought westwards from that great home of nomads, the centre of Asia, and has already obtained a large place in the agriculture of the Slavonic regions of eastern Europe in Roman times". Werth (1937) mentions, "after a consideration of the various theories of Vavilov, Schiemann, etc., it is concluded that the probable spread of this millet started from a broad girdle in North China, through Central Asia, South Russia into Middle Europe". Crozier (1894) is of opinion that this crop was introduced into the United States of America from the old world and, Brandon (1932) believes that the Russian emigrants brought this over with them.

Uses. This millet is characterised by its short period of maturity which makes it very suitable as a catch crop. It has a very low water requirement (about two-fifths of what is required for wheat) and is able to evade drought by its quick maturity (Brandon, 1932). In the northern coastal districts of the Madras presidency it is raised as a dry land crop. It is sown in the late sowing season (October – November) and yields about 500 lb. of grain to the acre. In the southern parts of the presidency, it is raised in the cold (dewy) weather, invariably as an irrigated crop, when it yields close on 1000 lb. of grain per acre.

In the old world this millet is cultivated for its grain which is used as human food. In India it is husked, cooked and eaten like rice (Watt, 1901). In America it is used chiefly as a forage crop. Bailey (1922) mentions the following uses of this millet in America: "The seed is fed to stock and is used as a substitute for corn in areas where corn will not succeed and the sorghums will not mature. It is fed particularly to hogs. This practice gives it the name of hog millet. It is also an excellent poultry feed. Its protien content is almost as good as wheat."

Botanical Description. Hooker (1875) and Blatter (1935) have described this millet. In the following brief description we have freely drawn from them and have incorporated our special observations. *Panicum miliaceum*, L. belongs to the tribe *Panicae*, in the natural order Graminae. It is a herbaceous erect annual with a tendency to tiller freely, growing up to a height of 2—4 feet. It is leafy often up to the panicle and the leaves are linear and slender. The leaf sheaths enclose almost the whole internode. The ligule is short with a fringe of silky hairs. The leaf blade and sheath are very often covered with long hairs arising from conspicuous tubercles.

The panicles are slender, usually curved and nodding with long slender branches which are much divided even up to the fifth degree. The main axis is 6 to 10 inches long and from this 10 to 15 primary branches arise often singly, and sometimes in whorls of two or three along the length of the axis. The lower primary branches are longer and heavier than those higher up. The primary branches give off secondary branches. These again divide up further and further into ultimate thread-like branchlets each of which bearing two and very rarely three spikelets at the tip. The spikelets are about $\frac{1}{5}''$ long and have 4 glumes which are glabrous, unequal, cuspidate and prominently nerved.

Glume I. is small and is about $\frac{2}{3}$ the size of Glume III.

» II. is almost as big as Glume III.

» III. is paleate neuter. Sometimes three stamens arise in this flower.

» IV. is broadly ovate, turgid and cartilegenous. The palea is of similar material. These enclose a full flower consisting of three stamens and one ovary with two plumose styles. There are two fleshy lodicules.

The kernel is firmly surrounded by the indurated shining glume and palea which are often coloured. The ripe grain easily sheds. The kernels form about 70 per cent by weight of the grain.

Anthesis and Pollination. With a view to effect successful hybridisation, pollination studies were made on this crop. They were on the field crop at Coimbatore which was in flower during the month of February 1937, the regular growing season of the crop.

From the appearance of the tip of the panicle at the collar of the flag, to its complete emergence from the flag sheath it takes about one week. The opening of the mature flowers does not wait for the complete emergence of the panicle. The flowers which are at the tips of the panicle start opening within 4 days from the appearance of the panicle. The flowering proceeds from top downwards. It takes about 10 days for the panicle to complete its flowering, though the bulk of the glumes open within the first week. Flowers open between the hours 10 a. m. to 12 noon, though stray flowers could be found to open till 1 p. m.

Coming to a typical individual flower, when mature, its fourth glume and palea slowly open out until they make an angle of about 50° between them. The anthers crowd in a column at the mouth of the slit and gradually slip out from between the glume and palea as they widen out. The stigmas whose long styles are bent and interlocked in the bud stage, release themselves and quickly droop out. The anthers dehisce longitudinally, about half a minute after their first appearance at the slit of the glume. This however varies with weather conditions. If the forenoon is very hot, the dehiscence is almost simultaneous with the appearance of the anthers. If the weather is cloudy, the dehiscence of the anthers is delayed by about a minute. In such weather, the flower opens later and the glumes keep open longer. A flower opens and closes in 5 to 7 minutes normally, depending however upon the weather conditions. The stigmas and anthers remain outside when the flower closes.

This millet is as a rule self-fertilised, though a very small amount of natural crossing does occur. The little interval between the opening of the flower and the dehiscence of the anthers makes this possible.

In this connection it will be interesting to note the experience of other workers in the pollination of this millet. Youngman and Roy (1923) studied the pollination of some lesser millets in the Central Provinces and were of opinion that they were mostly self-pollinated. Knuth (1909) mentions that stigmas and anthers protrude simultaneously and that the anthers approach the stigmas when the glumes close so that crossing is favoured at first and automatic self-pollination is possible later on. In Russia, Belov (1914) finds that pollen is shed within the flower before it actually opens and that self-fertilisation is invariable. He states that some natural crosses have also been met with by some workers on this millet. In Poland, Lewiki (1921) confirming the statements of Belov, notes that the opening of the flower

takes place from about 8 a. m. to 1 p. m. and was of opinion that the slight natural crossing that occurs is caused by insects and not by wind.

Artificial hybridisation. The very short interval between the opening of the flower and dehiscence of the anther makes artificial crossing a matter of very great difficulty. Emasculation has to be done well before there is any risk of taint from the readily available pollen. Youngman and Roy (1923) found that the slight pressure on mature flowers caused by passing the earhead through one's closed hand resulted in the opening of many mature flowers. At the Millets Breeding Station it was observed that on windy days a large mass of flowers opened simultaneously and earlier than usual. This earlier opening under pressure of hand was however found not to be early enough for safe emasculation. What was wanted was a little more time between the opening of the glumes and the dehiscence of the anther so that the emasculation could be done safely and without risk not only from the pollen from the same flower, but also from pollen available at the usual time of mass flowering. By examining the earhead, noting the mature flowers likely to open that day and passing such *individual flowers* gently between the thumb and fore-finger it was possible to induce them to open out earlier, by even an hour before their due time of opening. Flowers take about three minutes to open after the manipulation. The anthers in this case take a little longer time to dehisce and the emasculation is done quickly and safely. The desired pollen is also secured in a similar way. This method is essential for designing crossing work with parents whose F_1 characters cannot be depended upon to give a clue to successful crossing. But in the case of such known characters as purple pigmentation whose dominance over the green throughout is well known, it will be simpler to adopt the contact method of crossing described in detail elsewhere in connection with *Eleusine coracana* (Rangaswami Ayyangar, 1932). This method has been successfully used by Kadam (1935) in the case of this millet.

While at this subject of anthesis it may be recorded that odd instances have been met with in which the third glume which is usually neuter, has borne 3 stamens. These stamens were normal and they dehisced and shed their pollen after the anthesis of the bisexual flower. Another interesting floral abnormality is the presence of a fifth glume with a palea and a grain in between, producing two seeds in one spikelet. This was met with in a sample of seed from Russia (Belov, 1916). The glume and palea in this instance are absolutely like the fourth glume and its palea. The central axis is slightly prolonged and an extra grain borne. Such abnormalities occur mostly in the tip florets of the panicles. The manifestation of this doubleness is not constant in all the plants, nor earheads, nor in all the spikelets. Ten is the largest number of double grains observed in a single head. In a random sample of 50 heads only 21 showed double grains which ranged from one to 10. Most of the heads showed this doubling in one or two spikelets only. When double, the grains are small and not well

set. Beyond being an interesting curiosity there are no economic possibilities in this doubling.

INHERITANCE STUDIES

The study of the inheritance of the characters of this plant is in progress at the Millets Breeding Station. The mode of inheritance of the three characters—Purple Pigmentation, Hairiness, and Grain Colour is presented below.

Purple Pigmentation. As in all cereals, in this millet also there are types with and without purple pigmentation. This millet being slender and the manifestation of pigment sparse, the pigment is not prominent. A close examination has to be made of the various parts of the plant to determine accurately the distribution of the pigment. That the pigmented condition is a simple dominant to the green-throughout condition has been published. (Rangaswami Ayyangar, 1927, 1928 and 1934.) Kadam (1935) confirmed this observation. Since publishing the above, many types of this millet have been under observation. In addition to the green throughout type, two purple pigmented types have been met with, viz., (1) *Purple* type—young plants occasionally purple on lower leaf sheaths, glume tips purple, stigmas purple, and (2) *Light Purple* type—purple seen only at reproductive stage and that under a lens, glume tip very light purple, stigma purple tinged. The commonest South Indian types are the *Purple* ones. Types that are green-throughout are poorly represented. The *Light Purple* type is only met with in varieties from China and Russia.

As in the case of *Ragi* (*Eleusine coracana*) (Rangaswami Ayyangar and Krishna Rao, 1931) a factor **(P)** produces the basic purple pigment of the type met with in the Light Purple group. The addition of an intensification factor **(I)** results in the ordinary Purple whose genetic constitution is thus **PPII**, the constitution of the Light Purple being **(PPii)**. Plants that are Green-throughout may be allelomorphic to either of these purple pigmented types. The presence of purple is a simple dominant to its absence resulting in a plant that is Green-throughout. The presence of the intensification factor **(I)** is a simple dominant to its absence, **(i)**. The **(I)** factor can manifest itself only in the presence of **(P)**. This factorial interpretation explains the 9 : 3 : 4 ratio of Purple, Light Purple and Green-throughout met with in crosses designed to throw light on the inheritance of these factors. The data from the cross is presented in the following table. (Table I). In the tables the abbreviation P. V. stands for *Panivaragu*, the Tamil name of this millet.

Hairiness. Hairiness is a characteristic of this millet. This has been noted in all the descriptions of this plant by various systematic botanists. It is however not known that there are various grades of hairiness in these plants including some which border on hairlessness.

From the examination of the pure lines collected and grown at the Millets Breeding Station for some years, varieties could be classified into four groups according to their hairiness :

(1) The *densely hairy* type. This is the most hairy type. Hairs are densely distributed on both the surfaces of the leaf, on the leaf sheath, stem, node and panicle branches. The hairs are about 5 mm. long, and are best seen on the leaf sheath. There are, on the average 400 hairs per square cm. on the surface of the leaf sheath and the same number is found on the upper surface of the leaves. Pure line P. V. 14 is typical of this.

TABLE I. Inheritance of Purple Pigmentation.

CROSS XIX.

Generation	P. V. No	Pigment Groups		
		Purple.	Light Purple.	Green-throughout.
Parents	P. V. 91			Female
	,, 199		Male	
F_1		F_1		
F_2	,, 220	104	33	44
Expectation 9 : 3 : 4		102	34	45
				P = ·9
	F_3 (from P. V. 220.)			
Family No.	*Character of Selection.*			
P. V. 269	Purple	168		
,, 259	,,	57	18	
,, 261	,,	25	8	
,, 264	,,	51	16	
,, 265	,,	36	11	
,, 260	,,	38		10
,, 263	,,	61		20
,, 266	,,	26		9
,, 262	,,	129	41	53
,, 267	,,	27	8	12
,, 268	,,	79	27	38
,, 270	,,	97	31	44
,, 272	Light Purple.		85	
,, 274	,,		92	
,, 275	,,		73	
,, 271	,,		86	28
,, 273	,,		69	21
,, 276	,,		91	29

(2) The *hairy* type. This is slightly less hairy than P. V. 14. The hair length is about 3 mm. As in P. V. 14, the hairs are present in all the plant parts, but not so densely. On the leaf sheath there are about 280 hairs per square centimetre of surface. As a pure line this is separable from P. V. 14. This group is represented by the pure lines P. V. 31 and P. V. 97.

(3) The *sparsely hairy* type. This type of hairiness is less hairy than P. V. 31 and is separable from it in pure lines. The hairs are only about 2 mm. long and are sparse even on the leaf sheaths. On an average there are 120 hairs per square centimetre. The leaves and panicle branches appear to be practically free from hairs. Pure line P. V. 36 belongs to this group.

(4) The *hairless* type. This type is devoid of hairs on the leaf, the upper leaf sheath, stem and panicle branches. This is however not absolutely hairless. The lower leaf sheaths and nodes are slightly scabrous. This type is very distinct from the above three types, and is easily distinguished from them. This is represented by P. V. 96.

P. V. 96 is an introduction from South Africa and is the only one of its kind in the collection of pure lines. Though it is a hairless type it is without any economic disability. In yield it is as good as any local economic selection. This is very unusual inasmuch as foreign introductions of this millet have not fared well at Coimbatore. The South African varieties have however been an exception. It is interesting to note that the varieties from the *Northern Circars* and the *Deccan* districts of this presidency are the most hairy and belong to group 1. Those from the central and southern districts are less hairy and belong mostly to groups 2 and 3. In the *Circars*, this millet is cultivated as a rainfed crop, while in the south it is invariably an irrigated crop.

The genetic relationship of these hair groups is interesting. Investigations in the inheritance of this hairiness pursued at Coimbatore show that the *hairless* condition is always recessive to the hairy condition. The *densely* hairy condition is brought about by the presence of three factors whose cumulative effect results in a dense manifestation of hairs on the plant. In crosses between the hairy and hairless types, the F_1 generation plants are less hairy than the hairy parent, but the heterozygous dominants in the F_2 are not easy of separation. This interference with the expression of hairiness in the heterozygous condition results in acute difficulty in the classification into sub-groups of hairiness, in the dominant hairy group. A cross between P. V. 96 (*hairless*) and P. V. 36 (*sparsely hairy*) resulted in a *sparsely hairy* F_1 and segregated into 486 *sparsely hairy* plants and 159 *hairless* plants in the F_2 ($P = .9$). Eight selections were carried forward to a third generation. Of these the four *hairless* selections bred true to hairlessness. Of the four hairy selections, two were true to the *sparsely hairy* character and two segregated again like the F_2 confirming the monogenic difference between the parents.

The second cross was between P. V. 96, the *hairless* parent used in the previous cross and P. V. 97, the *hairy* type. The F_1 was less hairy than the hairy parent and the F_2 gave a 15 : 1 ratio of *hairy* to *hairless* plants; the actual numbers being 281 and 23 ($P = .4$). The hairy group was inseparable into *hairy* and *sparsely hairy* sub-groups as the one ran into the other. It may be noted that P. V. 97 is from Russia. The plants of the F_2 were short and stunted in growth. The same *hairless* parent P. V. 96 was therefore crossed with P. V. 31, a local variety of the same hairy type as P. V. 97. The F_1 was similar to the last one and the F_2 segregated in a 15 : 1 ratio of *hairy* and *hairless* plants, the actual numbers being 564 and 25 respectively ($P = .04$). From this 35 selections were carried forward, 28 *hairy* and 7 *hairless*. In the F_3, the 7 *hairless* bred pure. Of the 28 *hairy* selections, 15 were pure and were of various indistinguishable grades of hairiness and 13 selections threw *hairless* plants. Out of these 13 segregating families, eight were of the 15 : 1 type (558 *hairy* and 39 *hairless*, $P = .7$) and five of the 3 : 1 ratio (139 *hairy* and 43 *hairless*, $P = .7$). This behaviour shows that the presence of a second factor for hairiness increases the amount of hairiness and brings it up to the *hairy* standard.

The third cross was again between the same *hairless* parent, P. V. 96 and the *densely hairy* type, P. V. 14. The F_1 was as expected, less hairy than the *densely hairy* parent. The F_2 segregated in a 63 : 1 ratio of hairy and *hairless* plants (335 hairy and 7 *hairless*, P = ·5). The hairy plants in the F_2 were of various grades of hairiness ranging from the *densely hairy* to the *sparsely hairy* condition so that it was impracticable to separate them into definite sub-groups, the heterozygous blends adding to the difficulty. The *densely hairy* type, P. V. 14 is a local variety, typical of the cold weather rainfed types common in the Guntur district. The hairiness in this type seems thus to be the effect of the addition of a third factor for hairiness.

From the above data it has to be inferred that hairiness is governed by the operation of at least three independent factors, any one of which produces hairiness and that the *hairless* type is the result of the absence of all these three factors. These factors are comulative in their effect, the intensity of the hairiness increasing with the addition of the factors. These three factors for hairiness have been designated $\mathbf{H_1}$, $\mathbf{H_2}$, and $\mathbf{H_3}$.

Grain Colours. The kernel of this millet is enclosed within the fourth glume and its palea. These two floral parts are indurated and shining. They are of various colours and this colour of the grain is the commonest varietal diagnostic character. The various types of grain colour met with so far and their inter-relationship and inheritance are described below.

Grain colours in *Panicum miliaceum*. The Common Millet.

		Colour of glume	Colour of palea.
(1) Dark Olive Grey	...	Dark Olive Grey	Dark Olive Grey
(2) Buff Yellow	...	Buff Yellow	Buff Yellow
(3) Light Olive Grey	...	Light Olive Grey wash	Dark Olive Grey
(4) Light Buff Yellow	...	Light Buff Yellow wash	Buff Yellow
(5) Ivory Grey	...	Ivory Yellow	Light Olive at base
(6) Ivory Yellow	...	Ivory Yellow	Light Yellow at base

Of these six colours Nos. 1 and 2, Dark Olive Grey and Buff Yellow are the colours met with in the Madras varieties. In varieties from Russia, South Africa and China, all the six colours are present. Except P. V. 96 (Ivory Yellow) the other types of grain colours have not taken kindly to their new surroundings at Coimbatore.

The starting point in this grain colour scheme for these six colours is Buff Yellow, which colour operates in wholeness on both the glume and the palea. The addition of the factor **O** to this basic colour **Y** results in the Dark Olive Grey colour of grain. The factor **O** is a simple dominant to **o**. Crosses between these two colours have given simple 3 : 1 segregations, the total figures obtained being 328 Dark Olive Grey and 101 Buff Yellow (P = ·5).

The other four grain colours represent stages in the reduction of the expression of whole colour on the glume and palea. Light Olive Grey and Light Buff Yellow represent the first stage. Here the colour of the glume gets

diluted to a mere wash, the palea practically retaining its full colour. This dilution of the colour of the glume is brought about by a factor **L**. The operation of this **L** factor along with the factor **O** is presented in the following table.

TABLE II. The Interaction of the Factors O and L

CROSS XXV.

Generation.	P. V. No.	Grain Colours			
		Light Olive Grey.	Dark Olive Grey.	Light Buff Yellow.	Buff Yellow
Parents	P. V. 36				Female
	„ 201	Male			
F_1		F_1			
F_2	„ 222	83	29	27	10
Expected 9 : 3 : 3 : 1		84	27·9	27·9	9·3
					P = 9
	F_3 (from P. V. 222 family).				
Family No.	*Character of Selection.*				
P. V. 294	Light Olive Grey	132			
„ 299	„	68			
„ 291	„	69	24		
„ 295	„	51	17		
„ 290	„	94		29	
„ 297	„	80		28	
„ 300	„	42		13	
„ 292	„	61	21	22	8
„ 293	„	104	32	36	10
„ 296	„	88	30	33	9
„ 298	„	33	12	13	5
„ 301	„	18	5	6	1
„ 303	Dark Olive Grey.		82		
„ 305	„		79		
„ 302	„		64		20
„ 304	„		98		31
„ 309	Light Buff Yellow.			64	
„ 306	„			37	11
„ 307	„			29	9
„ 308	„			69	24
„ 310	Buff Yellow.				86

From the above data it will be seen that a factor **L** dilutes the colour on the glume and that it is independent of the **O** factor in inheritance. The interaction of these two factors **O** and **L** results in the production of the four grain colours:— Dark Olive Grey, Buff Yellow, Light Olive Grey and Light Buff Yellow.

A second factor designated **I** inhibits the expression of colour on the glume making the glume Ivory Yellow. The effect of this inhibition is also felt on the palea. The colour of the palea is reduced and is confined to its base. This inhibition factor has also proved a simple dominant to whole colour. The interaction of the **I** and **O** factors is presented in the following table. (Table III).

From this table it will be seen that the inhibitory factor **I** operating independently of the **O** factor gives rise to the colours Dark Olive Grey, Buff Yellow, Ivory Yellow and Ivory Grey.

TABLE III. The Interaction of the factors I and O.

CROSS VII.

Generation	P. V. No.	Grain Colours			
		Ivory Grey	Dark Olive Grey	Ivory Yellow	Buff Yellow
Parents	P. V. 96			Female	
	„ 31		Male		
F_1		F_1			
F_2	P. V. 129	337	94	117	41
	Expected 9 : 3 : 3 : 1	331·4	110·4	110·4	36·8
					P = ·3
	F_3 P. V. 129 family				
Family No.	*Character of Selection.*				
P. V. 157	Ivory Grey	95			
„ 168	„	15			
„ 167	„	10	3		
„ 175	„	22	7		
„ 176	„	5	2		
„ 158	„	83		26	
„ 159	„	69		27	
„ 160	„	34		10	
„ 170	„	65		19	
„ 161	„	53	17	14	9
„ 162	„	34	12	10	3
„ 164	„	16	5	5	4
„ 169	„	33	11	12	4
„ 172	„	44	20	14	6
„ 186	Dark Olive Grey		92		
„ 187	„		69		
„ 189	„		121		
„ 163	„		17		9
„ 171	„		34		8
„ 185	„		59		20
„ 188	„		47		16
„ 190	„		46		11
„ 182	Ivory Yellow			87	
„ 183	„			26	
„ 177	„			3	2
„ 179	„			6	1
„ 180	„			23	10
„ 181	„			20	7
„ 184	„			26	9
„ 191	Buff Yellow				56
„ 192	„				64
„ 193	„				56
„ 194	„				58
„ 195	„				82
„ 196	„				81

Reddish Orange Coloured grain. This third whole-colour is a new one that was met with in the Russian and Chinese collection. The crop raised from this seed did not grow well and seems unsuited to Coimbatore conditions. This type was crossed with Buff Yellow, the starting point in the grain colour scheme presented above. The results of this cross are presented in the following table.

TABLE IV. Grain Colours Buff Yellow and Reddish Orange.

CROSS V.

Generation	P. V. No.	Grain Colours	
		Buff Yellow	Reddish Orange
Parents	P. V. 36	Female	
	,, 97		Male
F_1		F_1	
F_2	,, 128	289	106
	Expected on 3 : 1 basis	295	99 P = ·4
F_3 (from P. V. 128 family)	Character of *Selection*		
	Family No.		
	P. V. 147 Buff Yellow	123	
	,, 149 ,,	136	
	,, 156 ,,	104	
	,, 148 ,,	84	31
	,, 150 ,,	62	18
	,, 151 ,,	111	33
	,, 152 ,,	79	26
	,, 155 ,,	84	24
	,, 153 Reddish Orange		114
	,, 154 ,,		132

From the above table it will be seen that the grain colour Reddish Orange is a simple recessive to Buff Yellow. A factor $\mathbf{B_f}$ suppresses the red in this Reddish Orange and leaves the grain Buff Yellow in colour. Reddish Orange grains have the genetic constitution $\mathbf{YYb_fb_f}$, the Buff Yellow grains being $\mathbf{YYB_fB_f}$.

SUMMARY

The names, origin and distribution of the common millet *Panicum miliaceum*, Linn. are given in detail with a full botanical description of the plant. A review of the experiences in the anthesis and pollination of this millet is given together with a record of the observations at Coimbatore. For successful hydridisation it is found necessary to have a safe interval between the emergence of the anther and its dehiscence. It has been possible to secure this interval by proper manipulation of individual mature flowers, one hour before the usual opening time. Rare instances have been noted of the third glume bearing anthers and of the existence of poorly formed double grains, the doubling being brought about by the addition of an extra pair of fertile glume and palea.

There are two types of Purple Pigmentation in the plant, the Purple and the Light Purple. In the absence of the **P** factor for purple pigmentation the plants are Green Throughout (**pp**). **P** is a simple dominant to **p**. An intensificatton factor **I** makes the difference between the Purple and Light Purple types. Purple (**PPII**) is a simple dominant to Light Purple (**PPii**). A 9 : 3 : 4 ratio is obtained between Purple, Light Purple and Green Throughout.

The characteristic hairiness in the common varieties of this millet is governed by the operation of at least three independent factors any one of which produces hairiness. The hairless type is the result of the absence

of all the three factors for hairiness, namely H_1 H_2, and H_3. These factors are cumulative in their effect, the intensity of the hairiness increasing with the addition of each **H** factor. The *densely hairy* type is H_1, H_2 and H_3.

The common grain colours in the Madras varieties are Dark Olive Grey and Buff Yellow. A simple dominant factor **O** makes Buff Yellow into Dark Olive Grey. A second factor **L** lightens these two grain colours and produces the colours Light Olive Grey and Light Buff Yellow. Factor **L** which lightens the colour on the glume is a simple dominant to its absence. A third factor **I** inhibits the expression of colour on the glume making it Ivory in colour. It affects the palea also and restricts the colour to its base. Factor **I** is a simple dominant to its absence. The two grain colours Ivory Grey and Ivory Yellow are the result of the operation of this **I** factor. Reddish Orange, a third whole colour, is a simple recessive to Buff Yellow. A simple dominant factor B_f suppresses the Red in the Reddish Orange producing the Buff Yellow.

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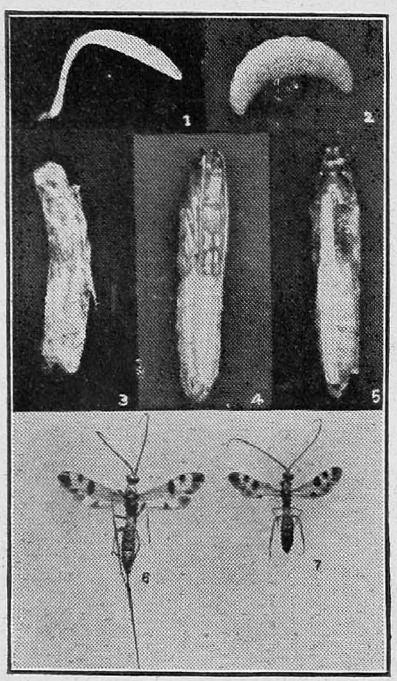
Panicum Miliaceum, L.

Densely Hairy.

Hairless.



Top left :	Egg—magnified.
Top right :	Grub—full grown.
Middle left to right :	Cocoon,
	Pupa—ventral view and
	Pupa—dorsal view.
Bottom left :	Adult—female.
Bottom right :	Adult—male.

STENOBRACON DEESAE, CAM. (HYM. BRAC.) A NATURAL ENEMY OF THE MOTH BORERS OF SUGARCANE

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Introduction. In recent years Entomologists all over India have been devoting a good deal of attention to the study of the insect pests of sugarcane. The authors have been making detailed studies of the moth borers and their natural enemies. Of the several parasites collected the results of the studies of the three larval parasites, viz., *Elasmus zehntneri*, Ferr., *Stenobracon nicevillei*, Bingh and *Rhaconotus scirpophagae*, Wlko., have already been published by the authors [1, 2, 3]. The present paper deals with *Stenobracon deesae*, Cam.

The parasite belongs to the sub-family Vipioninae. It was described by Cameron [4] from specimens collected by C. G. Nurse in 1902 at Deesa, Simla and Ferozepur. Dr. Ramakrishna Ayyar [5, 6], states that it is one of the chief parasites of the stem boring Pyralid caterpillars of cane, sorghum and pulses. It is reported as an important parasite of *Scirpophaga* by Husain [7] from Punjab. Narayanan [8] mentions it as a parasite of the sugarcane root borer, *Emmalocera depressella*, Swinh. It has also been recorded from Formosa, Java, Sumatra, China and the Philippines by Watanabe [9]. The authors have collected this parasite from sugarcane and sorghum fields from *Diatraea stictieraspis*, Hmps., *D. venosata*, Walk. *Chilo Zonellus Swinh* and *Scirpophaga* sp. The Coimbatore collections contain a single specimen of *deesae* labelled "from paddy".

Description of the Parasite. The following is the description of the parasite by P. Cameron :—

"*Long* 12, *terebra* 15 mm. *Habitat* Deesa. Antennae black, narrowed towards the apex ; the scape covered with blackish hair Head smooth and shining ; the face covered with long fuscous hair ; the clypeal depression deep, smooth and shining. Mandibles with the apical half deep black. The ocelli are bounded behind by two deep, curved furrows ; in front of them is a triangular depression. Thorax smooth and shining ; there is an oblique furrow on the base of the mesopleurae at the base above. Wings yellowish-hyaline ; there is a fuscous cloud between the base of the stigma and the transverse basal nervure and extending to the opposite side of the wing ; a cloud at the apex of the stigma extending to shortly beyond the middle of the cubital celluleo ; the apex of the wing to near the second transverse cubital nervure and on the lower side extended backwards to beyond the middle of the second cubital celluleo. The apex of the hinder wing and its lower side to the middle where it projects obliquely upwards along the cubital nervure, smoky. Legs luteous ; the apices of the tarsi blackish. Abdomen luteous, more or less suffused with black ; the basal three segmenst

irregularly longitudinally striated, the striae in places forming reticulations; the three transverse furrows are deep and closely, stoutly, longitudinally striated: there is no keel on the second segment; the smooth basal plate is small, indistinct and triangular.

The male is similar; the clouds in the wings are more suffused; the apex of the abdomen is black: the antennae are longer than the body."

Habits of the Wasp. The adult parasites, during May and June hover about in large numbers in sorghum and sugarcane fields. In the field the parasite flies from stem to stem prodding rapidly for a moment on each, to find out the presence of the borer inside. In grown up canes, all the borers except *Scirpophaga* sp. make their entrance into the stem by cutting a hole into the stem. During their larval life they also stray away from stem to stem on account of which there is always more than one hole on the stem. These holes are always filled with the frass, the freshness of which is a sufficient indication to the parasite of the presence of the borer inside. The larva of *Scirpophaga* sp., enters through the mid-rib, tunnel downwards into the stem and only just before pupation, constructs a small hole to the outside of the stem and closes it with a thin film of the outermost leaf sheath. It is only through this external opening that the parasite can thrust her ovipositor to parasitise the larva, whereas, the other borers are accessible throughout their larval life. In all cases of the attack of *Scirpophaga* sp., only one larva will be found inside the plant whereas in *Diatraea* sp., in some instances, more than one larva have been noted. On account of these two facilities, the parasite finds it easy to parasitise borers other than *Scirpophaga* sp., and this eventually explains how the parasite has been more often found to attack *Diatraea stictieraspis*, Hmps., and *D. venosata*, Walk., than *Scirpophaga* sp.

The adult parasite, when ready to emerge, crawls out of the cocoon by cutting a hole in it and comes out of the tunnel through the opening on the stem made by the host larva. Immediately after emergence the parasite is lethargic; mating takes place subsequently and the females are ready for egg-laying. The ovipositor measures 15 mm. long and if, during her thrusts, it encounters a larva, it paralyses the larva and lays an egg on or near the head of the host. Table I gives the egglaying records of 12 females. In the laboratory, on an average, each female laid 21 eggs, the maximum being 84. Just like its closely allied species *Stenobracon nicevillei*, Bingh., this wasp also possesses the habit of distributing its eggs but in so doing, it is not regular and definite. It lays one or more eggs on each and in one instance as many as 10 eggs were laid on a single host but in all cases only one adult emerged.

As a result of a series of trials it was found that (1) a host on which eggs have been laid once, is again parasitised by the same parasite or by other individuals of the same species, (2) the number of eggs laid on each host is indefinite, (3) if more than one host larva is supplied in stems, it distributes its eggs but not necessarily on all, (4) if one host alone is supplied to a number of parasites they attack the host simultaneously and lay eggs on it. (In one such attack 15 eggs were found laid), (5) if different species of

borers are given to a single parasite it shows no preference to any particular larva, (6) the parasite breeds parthenogenetically, the progeny in such cases being males, (7) when more than one egg is laid all the eggs hatch out but only one grub thrives.

Life History. The egg (fig. 1) is translucent, elongate and cylindrical with a highly drawn out pedicel which is $1\frac{1}{2}$ mm long. The whole egg measures $3\frac{1}{2}$ mm. The egg period ranges from 23-31 hours. If the pedicel portion of the egg is cut out, the egg does not hatch.

The newly hatched grub measures $1\frac{1}{2} \times \frac{1}{2}$ mm. The grub crawls about over the host and punctures its skin at some tender part of the cuticle and sucks into its stomach, the material from the host's body. As the grub ingests food from the host it becomes opaque attaining the color of the host. The grub reaches its maximum size of 15x4 mm. in 3-6days by which time the host larva is completely eviscerated. At this stage, it spins a white cocoon of silk and pupates in it. Under Pusa conditions Narayanan has noted the larval period to take about 22-25 days.

The pupa, when fresh, is white but in about two days the thorax and later on, the head turn black. It measures 12x3 mm. The pupal period ranges from 5-8 days.

Duration of the Life Cycle. The total life cycle of the parasite ranges from 13-20 days, the average for 30 cases being 12 days. Table II gives the detailed life history records of the parasites.

Longevity of the Adult Wasps. The adults were fed with honey solution. The maximum longevity for a female was 57 days and of a male 54 days, the average being 30 days. Table III gives the longevity records of 12 males and 12 females. Narayanan in Pusa has noted the longevity of the female to be "more than a week, even ten days" and of the males to be 36 hours.

Seasonal and Regional Prevalence. Field observations on the incidence of the parasite in Coimbatore show that the attack of the parasite is noticed in larger numbers from May-July. In March, April, August and September there is only a slight attack. The wasp has been collected in the Madras Presidency from the following districts: - Coimbatore, Ceded Districts, South Arcot, Vizagapatam and Tinnevelly.

Stenobracon nicevillei, Bingh. This is a species very closely allied to *S. deesae*. It was collected in 1901 by L. de Nicevillei and described by Col. C. T. Bingham [10]. In general form the two species apparently seem to be similar but there are specific differences between the two. It is easier to distinguish the females of both these species than the males. The dorsal surface of the fifth and the base of the sixth abdominal segments are black in the females of *S. nicevillei* while this dark band is absent in *S. deesae* (fig. 6). The males of both these species bear a similar dark band on the sixth abdominal segment but a broad black band running across the vertex of the head in *S. nicevilei* distinguishes it from *S. deesae* (fig. 7).

Efficacy of Stenobracon deesae as a Parasite. Since, only one parasite emerges from each host, it is a drawback in its habit to lay, in some cases, more than one egg on each host. It is also considered a drawback for any parasite to have a number of hosts. Though *S. deesae*, has a number of hosts most of them happen to be pests of the same crop.

With an ovipositor 15 mm. long, the parasite has the advantage of attacking the borers living in protected situations. At any stage of their larval life it is able to attack the borers. The duration of the total life cycle of the parasite, as compared with that of the host, gives it a favourable position for the control of the pest. It is also very easy to rear the parasites in large numbers in the laboratory as the host larvae are easily available from sorghum fields.

Acknowledgments. The authors wish to thank the Director, Imperial Institute of Entomology, London, for kindly identifying the specimens.

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TABLE I

Oviposition records of Stenobracon deesae, Cam.

	Female No. 1	Female No. 2	Female No. 3	Female No. 4	Female No. 5	Female No. 6	Female No. 7	Female No. 8	Female No. 9	Female No. 10	Female No. 11	Female No. 12
Emerged on	25 3 37	17 4 37	18 4 37	20 4 37	4 5 37	5 5 37	9 5 37	13 5 37	20 6 37	20 6 37	15 7 37	28 7 37
Date of Egg laying and the number of eggs laid.	30 3 37 4 1 4 37 3 2 4 37 2 3 4 37 6 4 4 37 3 6 4 37 1	24 4 37 1 26 4 37 1 28 4 37 4 29 4 37 2	19 4 37 1 20 4 37 1 21 4 37 10 22 4 37 1 24 4 37 3 25 4 37 1 27 4 37 2 28 4 37 3 29 4 37 1 30 4 37 2 1 5 37 2 6 5 37 3 12 5 37 2 13 5 37 2 14 5 37 2	21 5 37 2 23 5 37 2 26 5 37 2 27 5 37 2 30 5 37 2 1 6 37 1	6 5 37 2 13 5 37 2 14 5 37 3 15 5 37 2 21 5 37 3 27 5 37 3 30 5 37 1	9 5 37 1 10 5 37 1 12 5 37 4 14 5 37 2 15 5 37 2 19 5 37 1	23 5 37 2 25 5 37 2 26 5 37 4 27 5 37 3 30 5 37 1 31 5 37 7 9 6 37 1 11 6 37 2 12 6 37 2 13 6 37 3	13 6 37 4 15 6 37 2 16 6 37 1 17 6 37 1 21 6 37 2 22 6 37 1	4 7 37 3 4 8 37 2	24 6 37 1 28 6 37 1 4 7 37 1 6 7 37 1 7 7 37 1 8 7 37 1 10 7 37 1 11 7 37 1 14 7 37 1	20 7 37 1 21 7 37 2 22 7 37 7 23 7 37 3 26 7 37 6 27 7 37 4 30 7 37 6 31 7 37 1 1 8 37 5 2 8 37 3 3 8 37 2 4 8 37 2 5 8 37 7 6 8 37 1 7 8 37 4 8 8 37 1 10 8 37 2 11 8 37 7 12 8 37 1 14 8 37 5 16 8 37 14	31 7 37 2 1 8 37 1 2 8 37 2 5 8 37 2 6 8 37 6 9 8 37 1 11 8 37 2 12 8 37 3 4 8 37 2 15 8 37 1 16 8 37 4
Died on	8 4 37	29 4 37	7 6 37	1 6 37	7 6 37	20 5 37	26 6 37	24 6 37	6 2 37	16 7 37	18 8 37	18 8 37
Total No of eggs laid.	19	8	36	11	16	11	27	11	5	9	84	26

TABLE II.

Detailed Life-history records of Stenobracon deesae, Cam.

Ser. No.	Eggs laid on.	Name of the host supplied.	Larva hatched on.	Egg period in days.	Cocoon formed on.	Active larval life in days.	Pupated on.	Larval period in days.	Adults emerged on.	Pupal period in days.	Total life cycle in days.	Sex.
1	30 3 37	Chilo.	31 3 37	1	3 4 37	3	4 4 37	4	12 4 37	8	13	F
2	3 4 37	,,	4 4 37	1	7 4 37	3	10 4 37	6	17 4 37	7	14	,,
3	4 4 37	,,	5 4 37	1	8 4 37	3	14 4 37	9	20 4 37	6	16	,,
4	6 4 37	,,	7 4 37	1	10 4 37	3	13 4 37	6	20 4 37	7	14	,,
5	19 4 37	,,	20 4 37	1	24 4 37	4	28 4 37	8	5 5 37	7	16	M
6	21 4 37	,,	22 4 37	1	26 4 37	4	28 4 37	6	5 5 37	7	14	F.
7	24 4 37	,,	25 4 37	1	29 4 37	3	2 5 37	7	7 5 37	7	15	,,
8	27 4 37	,,	28 4 37	1	1 5 37	3	6 5 37	8	13 5 37	7	16	,,
9	28 4 37	D. venosata.	29 4 37	1	2 5 37	3	7 5 37	8	13 5 37	6	15	,,
10	29 4 37	,,	30 4 37	1	3 5 37	3	9 5 37	9	16 5 37	7	17	,,
11	30 4 37	,,	1 5 37	1	5 5 37	4	8 5 37	7	15 5 37	7	15	,,
12	6 5 37	Sesamia.	7 5 37	1	10 5 37	3	13 5 37	6	20 5 37	7	14	,,
13	12 5 37	Scirpophaga.	13 5 37	1	17 5 37	4	21 5 37	8	27 5 37	6	15	M.
14	13 5 37	Chilo.	14 5 37	1	18 5 37	4	27 5 37	13	2 6 37	6	20	,,
15	15 5 37	,,	16 5 37	1	19 5 37	3	24 5 37	8	31 5 37	7	16	,,
16	26 5 37	D. venosata.	27 5 37	1	31 5 37	4	3 6 37	7	10 6 37	7	15	,,
17	27 5 37	Chilo.	28 5 37	1	31 5 37	3	2 6 37	5	9 6 37	7	13	,,
18	31 5 37	,,	1 6 37	1	4 6 37	3	8 6 37	7	14 6 37	6	14	,,
19	9 6 37	Scirpophaga.	10 6 37	1	14 6 37	4	16 6 37	6	23 6 37	7	14	,,
20	12 6 37	,,	13 6 37	1	16 6 37	3	22 6 37	9	28 6 37	6	16	,,
21	15 6 37	Chilo.	16 6 37	1	20 6 37	4	25 6 37	9	2 7 37	7	17	,,
22	24 6 37	D. sticticraspis	25 6 37	1	29 6 37	4	5 7 37	10	12 7 37	7	18	F.
23	28 6 37	D. venosata.	29 6 37	1	5 7 37	6	8 7 37	9	15 7 37	7	17	M.
24	4 7 37	Scirpophaga.	5 7 37	1	11 7 37	6	14 7 37	9	21 7 37	7	17	F.
25	30 7 37	D. sticticraspis	31 7 37	1	4 8 37	4	9 8 37	9	16 8 37	7	16	M.
26	31 7 37	Chilo.	1 8 37	1	5 8 37	4	8 8 37	7	14 8 37	6	14	,,
27	8 8 37	D. sticticraspis	9 8 37	1	13 8 37	4	19 8 37	10	25 8 37	6	17	,,
28	9 8 37	,,	10 8 37	1	15 8 37	5	20 8 37	10	28 8 37	8	19	,,
29	12 8 37	Scirpophaga.	13 8 37	1	17 8 37	4	22 8 37	9	29 8 37	7	17	,,
30	14 8 37	D. venosata.	15 8 37	1	19 8 37	4	22 8 37	7	29 8 37	7	15	,,

TABLE III.

Length of Life of Stenobracon deesae, Cam.

Ser. No.	Emerged on			Died on			Sex of the adult	No. of days lived
1	25	3	37	8	4	37	F.	14
2	12	4	37	18	5	37	,,	36
3	17	4	37	29	4	37	,,	12
4	18	4	37	18	5	37	,,	30
5	4	5	37	7	6	37	,,	35
6	5	5	37	20	5	37	,,	15
7	5	5	37	14	5	37	,,	9
8	6	5	37	9	7	37	M.	34
9	13	5	37	28	6	37	F.	46
10	13	5	37	6	7	37	M.	54
11	13	5	37	28	6	37	F.	46
12	15	5	37	11	7	37	,,	57
13	20	5	37	9	7	37	,,	50
14	20	5	37	1	6	37	,,	12
15	27	5	37	23	6	37	M.	27
16	10	6	37	2	7	37	,,	22
17	9	6	37	22	7	37	,,	42
18	11	6	37	11	7	37	,,	30
19	11	6	37	2	7	37	,,	21
20	12	6	37	11	7	37	,,	29
21	14	6	37	2	8	37	,,	49
22	23	6	37	27	7	37	,,	34
23	16	8	37	15	9	37	,,	30
24	24	8	37	27	9	37	,,	30
Average longevity for females				...			... ...	30
Average longevity for males				...			... ...	32

FUTURE OF THE INDIAN MANGO INDUSTRY.

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[This is the first of a series of articles attempting a critical review of the present status of the fruit industry in India and its future possibilities. In this series an attempt is made to deal with each of the major fruits under cultivation and to discuss the peculiar problems with particular reference to the economic interests of the grower and consumer alike. Fruit industry is a national asset and a long range view is called for in any scheme for its development, and this again must be based on a correct evaluation of its present condition. The articles are primarily intended to focus the attention of those interested in the resuscitation of the rural side and at the same time in the betterment of the national health that is bound to follow an increased consumption of fruits by all classes of people. The interests of the prospective fruit growers and of those who intend extending their commercial orchards are kept in the fore-front in formulating the suggestions.]

It will be hard to think of a fruit which has appealed to the people of this country in a greater measure than the mango. From the point of view of acreage and production, mango is easily the most outstanding of all Indian fruits. The adaptability of this fruit to a very wide range of climatic and soil conditions, the relatively hardy nature of the tree, the low cost of its culture and maintenance, and above all, its healthful dietetic qualities and its universal popularity as one of the choicest of the table fruits have contributed to accord the premier place to the mango practically in every nook and corner of this country.

At present mangoes are cultivated in every Province of India, almost in every district excepting on higher elevations exceeding about 4,000 ft. above sea level. In tracts subject to severe winter conditions and to frequent frosts and hail storms or to extreme water scarcity, the mango is not of any great commercial importance. In other areas mango thrives provided the soil is not water-logged, saline, alkaline, rocky, extremely shallow or otherwise too poor for any cultivation.

A very large proportion of the mangoes produced in this country at present is from trees raised from seed. With the exception of a few stray trees and of a few varieties like *Olour* on the West Coast of South India, the fruits from such seedling trees are of no economic value, being of poor or indifferent quality. Among the grafted plantations, the usual practice is to stock the orchards with numerous varieties, in some cases numbering even over 100 in each garden. These veritable museums of variety collections detract the economic value of the mango industry, and must give place to a limited number of varieties in every commercial garden. Till this is achieved and the seedling orchards are made things of the past, the Indian mango industry cannot hope to rise to its full stature as a remunerative national industry. An immediate step in this direction is a practical

impossibility, but a planned programme for the future is both necessary and feasible. Propaganda backed by suitable state measures such as imposition of a higher tax on the ill-planned new plantations appear to be called for if a new orientation is to be given to this industry, which forms admittedly a valuable monopoly of this country even in its present disorganised condition.

Partly because of the environmental variations and mainly because of the varietal differences, there is often considerable variation in the mango bearing season in the various tracts of the same Province. The season opens with Olour, Alfonso and Pairi fruits in the Malabar Coast towards the end of February and lasts up to the commencement of the South-west monsoon in about the month of June all along the Arabian Coast from Travancore to the Northern parts of the Bombay Presidency. April to June is the main bearing season in the Northern Circars, while in Ceded Districts of South India where the second cropping varieties like *Neelum*, *Rumani* and *Bangalora* predominate, the season extends up to September. The early varieties like Bombay Green and Yellow start the mango season in the Western United Provinces and parts of Behar, followed by *Langra*, *Daschri* and *Safeda* in the mid-season, while Fazli tapers off the mango season in the Indo-Gangetic Plains till about the beginning of August. The absence of any regular winter weather in the south of India renders it possible to produce a valuable regular off-season crop of mangoes from September to January in this part of the country. These various factors denote that if a systematic attempt is made in every Province to grow only a few choice commercial varieties, the bearing season of which will not overlap with that in other Provinces or tracts, it will result in stabilising the prices of mangoes and prevent the gluts and consequent low returns to growers that unfortunately form an unpleasant feature of our present-day culture and marketing of the Indian mangoes.

Regulated orcharding, however, is a work that must be preceded by collection of accurate data on a variety of subjects, such as the acreage under each variety of fruits in every tract, the extent and cost of production, cost of transport and distribution and the quantity that is and can be absorbed in local, extra-Provincial and foreign markets. Thanks to the efforts of the Imperial Council of Agricultural Research, we are well on the way of obtaining up-to-date information on most of these items in a short period of time. The question of zoning of varieties with due difference to the suitability of the tract, and the existing or potential demand, the extension or restriction of the acreage in a given tract with special reference to the regulation of the quantity produced, to the season of bearing, cost of production transport and distribution facilities, etc.—need to be tackled as the next important item in the programme of development. At present, there are several areas which produce crops in abundance in certain seasons, while there is scarcity in the greater part of the year. In a number of places like the Punjab, the cost of production is considerbly higher and the risks are greater than in the Southern parts of the country. There is clearly a great deal of

scope for extension of the acreage under early, late, and off-season bearing varieties of Indian mangoes. Even among the varieties that bear in a particular season, there is vast scope for elimination of poor croppers and selection of a few remunerative types for extensive plantings.

Systemic planning will neither be complete in itself nor comprehensive in its scope if it does not take into account the improvement of the varieties in respect to fruit quality, productivity and tree-hardiness. A number of Indian varieties, like *Jehangir* and *Himayuddin*, though bearing fruits of outstanding quality are now discountenanced in commercial orchards, either because of their shy-bearing tendencies or lack of adaptability under adverse conditions. Even so, numerous high-producing varieties exist, which would have become valuable economic assets if only fruit quality in their case had been slightly better than what it is. Breeding of mangoes in order to combine quality, productivity, hardiness, regularity of bearing, optimum and prolonged bearing season etc. is a most fruitful field that has not been attempted so far and deserves the special attention of the research workers. Such lines of work are bound to be laborious and very prolonged, but it will be a pity if they are to be shelved merely on these grounds.

A line easier to follow and capable of producing earlier benefit to the industry is the selection of individual trees of outstanding merit and popularising the progenies of the same after subjecting them to adequate tests. Selection of rootstocks of merit suited to diverse conditions of soil and climate, ascertaining the most economic methods of orchard maintenance as well as the standardisation of rootstocks, scion varieties, and methods of propagation are also a few other major problems that require to be undertaken contemporaneously with the other measures for the amelioration of the mango industry.

It is sufficiently realised that the haphazard extension of fruit-growing industry makes the marketing problem not only very acute and difficult, but also fails to provide sufficient room for effecting any material and lasting benefit to all the interests concerned. It is obvious that the best of efforts to improve the market and marketing conditions will be of no avail, if the cost of production remains high and the quality of the fruit so low as not to meet the fancy of the consumers. There are a number of consuming centres where certain fruits can be imported at cheaper rates from other provinces than those produced in the vicinity. Again, there are places where the production of low-grade fruits are so abundant that the local markets cannot absorb them and the outside markets will not have them. Similarly, the enormous production of certain varieties at one place may synchronize with the season of similar fruits in the adjacent provinces, so that extension of markets is rendered difficult, if not impossible. These show that a planned development of the industry is the *sinequanon* for its success, and must be undertaken along with, or preferably prior to, the improvements in the marketing of the produce.

Mainly owing to the unsystematic development of the mango industry up to this stage, the utilisation of surplus fruits that do not find a ready sale in certain seasons is assuming a growing importance. In the case of a fruit like mango, in the production of which India is in an unique position, there is abundant scope for the exploration of outside markets for the by-products like pickles, chutney, jam, jelly, marmalade, dehydrated and crystallized fruits and beverages. These are all fruitful fields open to the Indian businessmen who have the necessary enterprise and capital.

The Indian mango industry is now reaching a turning point in the course of its development. Periodic crop failures on the one hand and localised over productions on the other have been responsible for the general instability of the industry. During the last few years the prices have sometimes reached such a low level that it was impossible for the growers even to realise the transport charges in respect of a few consignments. With an unorganised production, it is also not possible to secure favourable transport facilities, and this precludes the possibility of any large extension of market facilities. In its present condition, holding out the supplies under refrigeration do not offer much promise. Large scale development of canaries has to wait for results of applied research in this field. Despite all these factors, there is a manifest trend to increase the plantings under all sorts of varieties, even though reliable plants are not always possible to obtain. A planned programme of development is therefore urgently called for, if the industry is to effect any material progress.

It will be idle to attempt a discussion of the details of such a programme at this stage. To a certain extent, some of the persons engaged in trade have realised the complexities of the existing problem of unorganised production and have actually made attempts to make the best use of their dearly bought experience. It is not uncommon to come across some mango dealers who shift their operation centres from place to place adjusting themselves to the season of bearing. It has been stated that some of the well-informed agents carefully keep themselves out of the more important producing centres and confine their activities to those tracts where the produce though of smaller proportions and of relatively inferior quality are of greater value because of their different bearing season or the nearness of such tracts to more important consuming centres. The marketing staff of the Imperial Council of Agricultural Research are expected to release shortly more accurate information on these aspects and when these are compiled for the whole of India, they will serve a valuable basis for the horticulturists for their formulation of a rational programme of development of the mango industry in India.

Research Notes.

Forcing of Bananas. A pit of 5 feet cube was dug in the Banana Experimental Area-garden soil, Coimbatore, and the same was filled after exposing it to the weather conditions for a fortnight with a mixture of sand, red earth, surface soil, well rotten farm yard manure and 5 lbs. of milled groundnut cake. After giving 2 irrigations at an interval of a week, a broad leaved sucker of the variety *Vamanakeli (Musa paradisiaca* Linn., var. *Cavendishii*, Paxt.) was planted with the tips of the leaves cut off as is the practice in Hawaii. This plant flowered after 5 months and 28 days of planting and the bunch matured after 4 months and 13 days of flowering while the same variety planted in the bulk crop at the same time took more than 9 months for flowering and 5 months thereafter for the maturity of the bunch. Thus it is evident that with the special treatment given, a saving of nearly 3½ months in the life-cycle of this variety was effected. In addition to this, the bunch produced was half as much more in size and weight than the biggest bunch of the variety in the bulk crop This special bunch had 12 hands, 201 fingers and weighed 58 lbs. while the biggest in the bulk crop had only 9 hands, 130 fingers and weighed 38 lbs.

Specimens for exhibition purposes can be produced in like manner.

Agricultural Research Institute,
Coimbatore,
25th May 1938.

K. Cherian Jacob.
Assistant in Botany.

Paraffin Wax as a Remedy against the Silver-Fish Nuisance. In the course of attempts made at the cotton laboratory, Nandyal, to save posters and charts hung on the walls from the ravages of the silver-fish, it has been found that paraffin wax answers the purpose well. Application consists of coating with a flat brush a thick solution of paraffin wax in kerosine oil. This is obtained by melting paraffin in a suitable receptacle and adding kerosine just before congealing sets in. A good proportion is 2 ounces of paraffin to 5 ounces of oil. Painting has to be done on both the surfaces as well as the edges. The kerosine evaporates away leaving a film of transparent paraffin on the surface. Excess deposit caused by unsystematic or slow brushing can be removed by scrapping off gently.

A poster treated in this way keeps safe from the attacks of the Silver-Fish for a long time. A trial made in the laboratory where 2 similar charts containing written matter, one paraffin coated and the other without, were hung on the wall showed that while the control suffered defacement in 2 months, the treated remained normal for several months. The coating has to be renewed periodically.

The advantage of this solution lies in its cheapness and harmlessness in handling. An obvious disadvantage is the change in colour caused by the kerosine solution. But the tint that develops is uniform and does not affect the exhibition on the poster. A more discouraging defect is the fact that it is apt to catch dust sooner. But this can be removed by passing a bit of clean rag gently and firmly over the poster in one direction. The surface gets clear again.

Agricultural Research Station,
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L. Neelakantan.
Cotton Assistant.

EXTRACTS

Calcium Lactate as a Milk Substitute. Experiments carried out by the Nutrition Research Laboratories, Coonoor, on a group of south Indian school children, who were given a daily dose of calcium lactate instead of milk for a period of 3 to 4 months, show that the children increased in height and weight as compared to other groups which received no calcium lactate. It was found that the calcium lactate groups put on more weight, and showed also a slight increase in stature.

The calcium lactate had a good effect on the general condition of the children although the calcium salt does not, as might be expected, equal milk in value as a supplement. It does however help to make good one serious deficiency, and is a *partial* milk substitute.

What it Costs. To supply a child with a daily drink of 8 ozs. of liquid skimmed milk reconstituted from powder costs about 12 annas per month. The supply of such milk in schools on a large scale would mean considerable expense. Children who need milk most are those whose parents can least afford it.

In the experiments with calcium lactate half to one gramme of calcium lactate was given daily at a cost of about half to one anna per child per month. This is by no means a large expenditure and the regular administration of a calcium salt might be feasible even in the poorest schools. Milk is best, but in present circumstances, calcium lactate is better than nothing. Its provision may be recommended to Educational Departments and other organisations concerned with the care of children. The calcium salt could be dispensed rapidly and easily from a tin with a spoon of suitable size.

A daily dose of calcium lactate may benefit children in other countries besides India It would probably make a very useful dietary supplement for children in Africa and many other parts of the world for whom milk is not available and whose staple diet is rice or some other food deficient in calcium.

The Coonoor experiments suggest a new approach to the problem of malnutrition among such children. (*Indian Information Series*, Vol. 2, No. 9. June, 1. 1938.)

What Humus is : Chemical Constituents. The explanation is simple. When a putrefaction of dead plants is completed there remains a soft black mass known as vegetable mould or humus. According to Johnson, one hundred parts of the humus of wheat straw have of extractive, or apotheme, rather more than 26 parts, and the residue is lime peroxide of iron, phosphate of lime, and carbonaceous matter. This apotheme contains carbon 46·6, hydrogen 20, and oxygen 33·4. At one time it was believed that this apotheme is the immediate fertilizing component of organic manure, being soluble in some circumstances, and entering at once into the roots of the plants, dissolved by the moisture of the soil. Modern chemistry research opposes this view, and it is now regarded as tolerably certain that a chief nutritive portion of vegetable manure is their carbon converted into carbonic acid, absorbed either in solution with the earth's moisture, or in gaseous forms by the roots.

Humus is the term applied to all forms of decayed animal and vegetable matter in the soil. It is frequently, but not always, the cause of the dark colour of soil. This characteristic is usually desirable for the reason that dark soils absorb solar heat freely, and therefore play an important part in plant growth and development. Humus may be added to the soil by the addition of animal manures, weeds, leaf mould, garden litter, and plant and animal refuse of any kind. For this reason the saving of weed and plant refuse, and its storage in

compost pits of heaps until it is thoroughly rotted is recommended. The stouter parts of plants, such as prunings, broken boughs old roots, and also large bones, should be burned before they are added to the soil. Where circumstances permit humus can be restored to soils by sowing Beans and Peas in Autumn and turning them under in Spring as green crops. (*The Fruit World*, February 1938.)

Agricultural Jottings.

(From the Director of Agriculture, Madras.)

MARKETING SURVEY OF FRUITS IN THE MADRAS PRESIDENCY

The Marketing Section has completed the surveys of the following fruits, namely, plantains, grapes, pineapples, apples, pears, oranges, limes, other citrus fruits and mangoes. Some of the salient features in the marketing of these fruits are presented in this note.

Among the several provinces in India, Madras easily leads in fruit production, the area under these fruits during 1936–37 being as follows—Mangoes 244,945 acres, plantains 132,777 acres, oranges 13,000 acres, limes 8 500 acres, pineapples 330 acres, grapes 250 acres and pears 500 acres. The marketable production, exports, imports and nett available supply are given below:—

	Marketable production	Imports	Exports	Nett supply
		(Figures in 000 railway maunds)		
Mangoes	20,000	,,	400	19,600
Oranges	447	134	20	561
Plantains	33,291	,,	206	33,085 (as bunches)
Limes	1,215	5	117	1,103
Pineapples	45	4	,,	49
Grapes	18	7	1	24
Apples	,,	13	,,	13
Pears	215	,,	9	206

Mangoes. Madras Presidency exports annually about 400,000 railway maunds of mangoes, the chief importing provinces during 1936–37 being Central Provinces (83,000 maunds), Bombay (55,000 maunds), Punjab (52,000 maunds), Hyderabad (51,000 maunds), Bengal (41,000 maunds), North West Frontier Province (22,000 maunds), Bihar and Oriss (32,000 maunds), Burma (26,000 maunds), Delhi (19,000 maunds), Indore (8,000 maunds) and Sind (8,000 maunds).

The largest exporting districts are Vizagapatam, East Godavari, Cuddapah, Chittoor, North Arcot and Malabar. Except in the case of Malabar which has the advantage of an earlier crop in February-March, mangoes of all producing centres of the Madras Presidency compete in local and North Indian city markets, with results disastrous to exporters in a short producing season. There have been instances when even the railway freight and incidental charges have not been recovered. There is therefore need for restricting the extension of mango cultivation of the main crop, and limiting the plantings to choice varieties and to off-season bearers, as in Tinnevelly and parts of Coimbatore, Tanjore and Circars. Expansion of export markets offers one way out of the difficulty, and there appears scope for foreign trade especially as the mango crop is cultivated very little out of India except in Mexico, Peru and Egypt. For the above purpose, cold storage methods with choice fruits are essential. In the already existing trade to North India, regulation of exports by a properly controlled system of producers' organisations, as is being done in America, is a useful step. The

Marketing Section has recently organised Fruit Growers' Associations in Vizianagram, Koduru (Cuddapah district) and Puttur (Chittoor district) to help export trade. The utilisation of the mango and other crops in the preservation industry will be dealt with in a later section.

Plantains. The plantain crop is next in importance in export trade, the quantity exported during 1936—37 being 206,000 railway maunds distributed among other provinces as follows:

Mysore State (90,000 maunds), Bihar and Orissa (46,000 maunds), Nizam's State (40,000 maunds), Delhi (11,000 maunds), Central Provinces (11,000 maunds), Bengal (5,000 maunds) and Punjab (3,000 maunds) from the Cauvery and Godavari areas. Exports to Mysore State have declined from 130 000 railway maunds in 1934—35 to 90,000 railway maunds during 1935—37, mainly due to increased cultivation in the State. The trade from the Godavari area has moved to places like Delhi and Lahore, due to special reduced rates, recently given by the Railways, on the recommendations of the Agricultural Department. The plantain crop offers more risk in export trade than many other fruits. For trade to such a place as Delhi, the railway freight per wagon is about Rs 800, cost of fruits Rs. 600 and incidental charges about Rs. 300 or a total of Rs. 1,700 invested on every wagon. The difficulties in export to North India are greater from the Cauvery area, where the railway freight is Rs 400 more per wagon. The city of Madras consumes annually about 250,000 railway maunds of Poovan and Rasthali varieties from the Cauvery area, 60,000 railway maunds of Mauritius or green plantains South Arcot and about 30,000 railway maunds of hill plantains from the Madura hills. Other markets for hill plantains are mainly in Madura and nearby districts and the prospects of export trade to North India appear remote. Although Malabar is a large producer of plantains, it is still a nett importer.

In world trade, the importing countries for plantains are the United Kingdom the chief exporting countries being Jamaica, Mexico, Panama and Guatemala. The variety exported is mainly Mauritius under cold storage. In our country, besides reduced rates to North India, for long distance traffic, wooden wagons with ventilators have been arranged for plantains by the Marketing Section, and the extension of such facilities is under consideration.

Citrus Fruits. The area under citrus fruits in the Presidency has increased from 10,000 acres in 1931—32 to about 22,000 acres at present. Still our Presidency is a large importer of oranges, mainly from Central Provinces of Sangtara variety (74,000 maunds) and of Coorg oranges (60,000 maunds). There is therefore scope for increased cultivation both on account of increasing demand and increasing imports. About 65% of the orange gardens in the province are yet to bear fully. The estimated Madras production by varieties is Sathgudi (96,000 maunds), Batavian (99,000 maunds), sour oranges (130,000 maunds) other types (139,000 manuds). The United States of America and Mediterranean countries are the largest producers and exporters of oranges, the world production being of the order of 53 lakhs of tons, the export trade of United States of America alone being annually 1·7 lakhs of tons and imports to United Kingdom 5·2 lakhs of tons. Scope for increased cultivation of Kamala oranges exists in the Circars. Extension of graft cultivation in choice varieties is also a useful step in improvement. On the side of marketing of oranges, a Fruit Growers' Association was started recently at Koduru in the Cuddapah district, and sold about Rs 23,000 worth of Sathgudi oranges last season in Madras city which consumes annually over a lakh of maunds of oranges, comprising Sangtara (52,000 railway maunds), Sathgudi (33,000 maunds) and Batavian and Kamala (18,000 maunds). Arrangements are being made to develop an export trade to other provinces with the Sathgudi variety and an Association at Puttur in the Chittoor district has also been started.

The lime crop also figures prominently in export, and about 117,000 railway maunds of the fruits were exported during 1936 -37, 80% of which was to Calcutta and the rest to Travancore and Burma. Due to large production, restriction of cultivation at any rate in the larger producing areas is indicated. The consumption of Madras city is annually 32,000 railway maunds of limes. Recently a Lime Growers' Association has been started at Palakol to help in export trade.

Other Fruits. *Grapes:* The area under grapes in our province is small and the production of 18,000 railway maunds is mainly of sour grapes from Kodaikanal and Krishnagiri. Consumption is mostly local as in Madras city and Madura and a very small quantity (900 maunds) is exported to North India from Krishnagiri. The grape season February-May has the advantage of production when Northern India supplies are scarce, but the main line of improvement is the evolution and acclimatisation of choice types akin to those from Chaman and foreign countries. A Grape Growers' Association has been started in the Madura district and exports to places in Madras and outside are in full swing. In the first one month of the starting of the Society nearly 7,000 baskets (1 basket—25 pounds) of grapes have been marketed in Madras and mofussil centres of the Presidency. International trade in grapes is of the order of 2·42 lakhs of tons annually and the large exporting countries are Spain, Italy, United States of America and South Africa.

Pineapples: Pineapples are grown in Malabar and Vizagapatam districts and production is reaching a surplus stage, and comprised Kew (22,000 maunds), Mauritius (5,000 maunds) and local types (17,000 maunds). The wholesale prices range about nine pies per pound in local markets, and from nine pies to one anna per pound in city markets as Madras. Imports are made from the Travancore State.

Apples: The apple is pre-eminently an imported crop confined to cities and the quantities imported are small compared to our vast supply of local fruits. Apple production in the province is small (70 maunds) and foreign imports amounted during 1936—37 to 9,500 railway maunds of value Rs 91,800 mainly from Japan (2,650 maunds), South Africa (1 929 maunds), United States of America (1,215 maunds) and Australia (2,418 maunds), besides 3,800 maunds from North India.

Canned and Preserved Fruits On account of our vast production and frequency of gluts in the producing season, there is scope for industrialising our vast fruit resources in such crops as the mango where production is 9 lakhs of tons, of pears (8 000 tons) and pineapples (1,800 tons). Research investigations on the technique of canning these fruits to suit local conditions and demand have to be immediately taken up. There is also a very profitable scope for the beverage industry in such fruits as limes (50,000 tons), and also of the sour oranges of Guntur (5,000 tons) which in addition to reputed medicinal value makes an excellent squash. Our presidency imports annually about 2½ lakhs of rupees worth of canned preserved fruits. Even if a fraction of our surplus fruits be canned, the imports will be checked considerably and the grower will get better value during the glut season.

Research. Improvements in the marketing of fruit should be directed to our immense resources of supply. A planned distribution of choice commercial varieties, restriction of areas in surplus crops as the mango and lime, encouragements of off-season bearers are the lines of attack on the research side. Centralisation of research to suit different fruits and growing areas appears a useful line of improvement. On the side of development of exports, investigations of cold storage methods are indicated for choice fruits in order to prolong the marketing season.

MARKETING OF HIDES AND SKINS IN MADRAS

That an export trade in tanned hides and skins valued at about five crores of Rupees annually has been built up in Madras, indicates the importance of tanning industry in the province. There were in 1930 about 500 tanneries which now stand reduced to nearly 425—a clear indication that this premier industry is far from flourishing. Some of the smaller concerns being unable to withstand the strain of losses in depression had to close their business never to revive.

Raw Goods. The raw materials required for the industry are made up of local production supplemented by imports from other provinces. Based on the livestock population of the presidency, the production of raw hides and skins amounts to over 12 million pieces (the two types in nearly equal numbers) valued at Rs 20 millions as compared to 25·4 million pieces of value 74 million rupees for the whole of India. Madras imports about 1¾ million raw hides mainly from Calcutta while her export trade in raw hides is negligible amounting to only 0·15 million pieces a year. The raw goods from Calcutta usually arrive dry salted or arsenicated so that they could be preserved long before being processed in tanneries.

The annual imports of raw skins (goats and sheep) are of the order of 12 million pieces and exports 2½ million pieces. As in the case of raw hides, the largest imports of raw skins arrive by rail from other provinces such as Mysore, Bombay, Central Provinces, Punjab and Nizam's Territory. The United Kingdom, our largest purchaser of goat skins, took nearly two million pieces (1212 tons) in 1935—36 and Australia was the next best importer followed by United States of America. Compared to goat skins the export trade in raw sheep skins is negligible, Ceylon being the only regular purchaser of small quantities.

Twenty-three and a half million pelts consisting of 7¾ million hides and 15¾ million skins represent the nett supply of raw stock available for tanning in the presidency. Of these nearly a million hides and 1½ million skins undergo complete tanning which convert them into finished leather, while the rest are processed into half-tanned products, the so-called tanned hides and skins of the export trade. The final processing of these unfinished goods is taken up in the United Kingdom and other European countries.

The tanning process is an elaborate operation occupying a period of 5 to 6 weeks, and consists of liming, dehairing, fleshing, deliming, scudding, refleshing, immersion in tan liquor, myrabolam bath, oiling, drying, staking and fluffing.

By far the most important of tanning materials used in South India is the bark of *avaram* (*Cassia auriculata*), a small shrub fairly common in many districts especially Cuddapah, Anantapur, Chittoor and North Arcot. Mysore and the Nizam's Territory also produce very large quantities of the bark and export considerable quantities to Madras. The stripping of *avaram* bark is an extremely tedious process as the shrub has branches and twigs of only about ¾ inch diameter. *Konnam (Cassia fistulata)* is another bark largely used in tanning mixed with *avaram* in various proportions. Compared to *avaram* it is cheaper by about 33 per cent. Wattle bark, which was first imported from South Africa during the war, as the supply of *avaram* and *konnam* barks could not cope with the enormously increased tanning of hides, has now become indispensable in tanneries. It is more economical than *avaram* bark as 1 to 1½ lb. only are required for tanning one pound of leather as against 3 lb. of avaram, the price of the two barks being almost the same.

The tanning contents of the three barks are as follows:—

Wattle bark	...	33%
Avaram	...	15%
Konnam	...	10 to 12%

The annual imports of wattle bark amount to 13,000 tons valued at Rs. 13 lakhs.

Tanned hides and skins. A little over 25,000 tons of tanned products constitute the annual output of tanneries. On a small scale, the processing of hides and skins is also carried on as a cottage industry, but the business is very much on the decline. A quantity of 3700 tons tanned stock intended for re-export is annually imported chiefly from Mysore and Nizam's Territory. The foreign exports of tanned hides and skins from Madras constitute 85 to 95 per cent of all-India exports and the Madras figures for the quinquennium 1931—32 to 1935—36 were as follows:—

Year	Tons (000)	Value Rupees (Millions)
1931—32	14·5	47·1
1932—33	13·5	42·6
1933—34	18·4	51 6
1934—35	17 0	48·0
1935—36	19 4	49·3

Exports during 1935—36 comprised cowhide (60%), Buffalo hide (6%), Goat skins (15%), Sheep skins (15%), and Calf skins (5%).

The export trade declined considerably from 1931 to 1933 but recovered to a great extent in the next three years. The United Kingdom is the largest importer of Madras hides and skins accounting for 85 to 90 per cent of the total exports from the presidency. Other importing countries are Japan, which has a special liking for low grade sheep skins and the United States of America with a preference for buffalo hides.

Internal demand.— Allowing for imports and exports the nett supply of tanned hides and skins available for internal consumption comes to 10,700 tons. Of these a little over 3000 tons tanned hides constitute the demand for mhote buckets (*Kavalais*) for agricultural operations. The rest of the tanned goods supplemented by the nett supply of finished leather are used up in the province for the manufacture of products such as sandals, shoes, boots etc.

The production of finished leather in Madras is estimated at 3400 tons. The annual imports and exports are approximately 1000 tons and 400 tons respectively leaving a nett balance of 4000 tons for local consumption.

Leather goods. From the available net supply of half tanned goods and inished leather an outturn of 10 million pairs sandals and 5 million pairs shoes and boots is estimated. The foot wear industry does not appear to be thriving well as a result of cheap Japanese goods such as canvas shoes being dumped into our country.

Prices. The slump in prices of all commodities including hides and skins which set in 1930 continued unabated till 1933. In 1933—34 there was a gradual recovery which more or less kept up though with temporary fluctuations until the middle of October 1937. Since then the tendency has been downward.

Distribution.—The system of marketing followed in respect of tanned hides and skins is to sell a portion of them against firm orders to England, America etc., and to send the rest to the public auction at London for redistribution to other countries. The exporting firms have established their own marks and qualities in foreign countries. Both in the direct order business and in the London public sales, the quality tannage and other factors affecting the value of tanned stock are known by the marks under which the goods are offered or shippped.

The tanned stock especially tanned hides and special classes of tanned skins sent to London, sometimes in execution of firm orders and under the special

trade marks of the exporting firms and at others on consignment are re-assorted and regrouped and sold by auction.

The absence of a common standard for the tanned stock appears to be a weak point in the present system of sale, though such a standardisation is beset with difficulties in view of the existence of various tannages and classes of pelts in the province.

Suggestions for improvement.—Propaganda to improve flaying in villages, and training and licensing of flayers at slaughter-houses seem to be essential. Mechanical flayers can also be introduced in suitable areas. Prohibition of branding the animals by propaganda or by legislation if necessary will result in the out-turn of better hides. The loss sustained by the country as a result of branding is estimated at a million rupees per annum and the practice of branding can be confined to the less valuable portions of the body as ears and neck.

In wet curing the salt applied is poor in quality and quantity. Research to find out cheap, easily applicable and efficacious substitutes is necessary. It will be helpful if the railway authorities include raw hides and skins under perishable articles and provide wooden wagons for their transport.

Grading.—A conference of representatives of the Indian tanning industry and marketing staff was held in July 1936 at Cawnpore and a workable system of standard grades drawn up. Grading stations for hides have been established at Agra, Delhi and Calcutta and about 136,000 hides were graded and marked under the grading and marking act, under the supervision of the marketing section. The gradual extension of a properly regulated system of grades and standards to develop export trade and serve as a basis of marketing intelligence, is being taken up.

A PRESS NOTE ON THE DESIRABILITY OF EXTENDING THE CULTIVATION OF THE CASHEWNUT

The importance of the cashewnut in the economy of our province is not adequately appreciated. The Government therefore desire to draw the attention of the public to the following facts :—

The magnitude of exports. The value of the cashewnut kernels exported in 1935—36 from the Madras Province was over two crores and eight lakhs of rupees. During the same year the exports of cashewnuts from Bombay were valued at twentytwo lakhs of rupees. The following figures collected by the All India Cashewnut Merchants' Association indicate that the consumption of cashewnut kernels is still on the increase in the United States of America and Europe, and that there is yet considerable scope for the extension of the markets in Europe and India.

TABLE : I. **Cashew kernels exported in millions of pounds.**

Year.	To U. S. A.	To Europe and other countries and consumed in India.		Total.
	Shippable.	Shippable.	Non-shippable.	
1925	1·5	1·0	0·25	2·75
1926	2·5	1·25	0·37	4·12
1927	4·0	1·50	0·55	6·05
1928	5·0	1·25	0 67	6·92
1929	7 5	2 00	0 95	10·45
1930	8·5	2·0	1·05	11·55
1931	9·0	2 5	1·15	12·65
1932	9·7	2 8	1·25	13·95
1933	11·3	2·7	1·40	15·40
1934	15 0	3·5	1·85	20·35
1935	23 0	5·5	2·85	31·35
1936	30 0	5·0	3·50	38·50

Imports of raw cashewnuts In spite of the large production of the cashewnut in India, the supply of the raw cashewnuts does not appear to be adequate to meet the demand of the cashewnut curing and processing industry. Uncured cashewnuts are therefore imported into India from Portuguese East Africa, Union of South Africa, and Kenya Colony. The value of the imported cashewnuts is over twenty lakhs of rupees per annum, the share of Madras being to the tune of about fifteen lakhs. It is obvious from the following table that the imports are not declining and that there is the necessity for increasing the production in India by extending the cultivation of cashewnut.

TABLE II. **Foreign Imports of cashewnuts.**

Year.	Into the Madras Presidency.		Into the Bombay Presidency.		Total.	
	Tons.	Rs	Tons.	Rs.	Tons.	Rs.
1934—35	11,925	13,83,640	Figures not available.			
1935—36	12,764	16,80,836	3,532	4.43846	16,296	21,24,682
1936—37	11.035	14,48,660	6,278	8 06,058	17,313	22,54,718

The cashew kernel—a rich food. There is still considerable scope for increasing, if need be, the consumption of cashew kernels in India. The cashewnut is a rich food containing 52 per cent. oil, 2·5 per cent. ash and 21·5 per cent. proteins. The true digestibility of the cashewnut protein is as much as 96·23 and its biological value is 72·5 as against 57 9 for the groundnut. Its nutritive value is further enhanced by the presence of vitamin A and B_2.

The extension of cultivation. The cashewnuts are now grown in Travancore, Cochin, Malabar, South and North Kanara, Ratnagiri and the East Coast of Madras. It is one of the hardiest trees growing on laterite soils requiring neither manure nor much of cultivation. In sandy and gravelley red soils, it can also be grown. Dry lands which are unfertile and consequently unfit for regular cropping with annual crops can be used for cashewnut planting. For planting cashewnuts pits $1 \times 1 \times 1$ foot may be dug at the commencement of the rains. The pits should be 10 feet apart, but as the trees grow up, more space has to be provided and the weak plants can be gradually removed leaving finally about 100 trees to the acre i. e., a spacing of about 20×20 feet. If the germinating cashewnuts are picked up by crows, a nursery should be raised and the seedlings about one month old may be transplanted into the pits. Otherwise 2 to 3 nuts may be planted directly into the pits and subsequently less vigorous seedlings can be removed. For the first three years, the land would have to be fenced to keep cattle off. The trees will flower in the fourth or the fifth year and fairly heavy crops can be obtained from the tenth year onwards. The loppings of the branches of the tree can be used as fuel; and it will be quite easy to obtain on an average nuts worth Rs 50/- per year from an acre.

The Officers of the Agricultural Department will be glad to supply good seed and to advise prospective growers regarding the suitability of lands for cashewnut cultivation.

CAMPAIGN AGAINST HYACINTH IN NIZAMABAD DISTRICT

(From the Director, Information Bureau, H. E. H. the Nizam's Government.)

Two years ago, a weed known as the Bengal Hyacinth was observed in the Nizamabad District. This is a highly dangerous weed and, if unchecked in time proves most expensive and devastating to agriculture. In Bihar and Bengal it could not be eradicated even at an enormous cost. It was particularly likely to play havoc with agriculture in the Nizamsagar Project area. The attention of

Government was therefore drawn by the Revenue authorities to the urgency of the problem and a note of warning sounded to the effect that if the weed was allowed to grow, it would before long jeopardize the economics of the Project itself. It was found however that the destruction of this weed could not be accomplished by the efforts of the Government alone without the active co-operation of the people themselves. Hence a scheme based on "Voluntary Service" was prepared to celebrate the 1st and 2nd of Khurdad (5th and 6th April) as the Bengal Hyacinth Days when the sympathy of volunteers was enlisted to remove the weed from the tanks, channels, pits, etc. Government sanctioned two days holiday for this purpose so that the Government officials, vakils and public-spirited men and women might join hands with the villagers in the task of eradicating the weed.

Two days before the date, a largely attended meeting of officials and non-officials was convened at the Town Hall where the objects of the compaign were explained and after mutual consultations suitable zones were allotted to different offlcers. The general supervision of the work was undertaken by the First Taluqdar in collaboration with the District Suprintendent of Police while the Second Taluqdars looked after the work in greater detail in their respective spheres. The response of the public to the official appeal was splendid and numerous officials and villagers stood side by side knee-deep in the mud picking and throwing out the weed. For two days continuously large parties of volunteers, both official and non-official, enjoyed themselves in the work of removing the hyacinth from tanks to channels. This was the second year of the campaign and it is felt that the weed this year has grown less. Similar campaigns, if carried on regularly for 4 or 5 years, are expected to eradicate the hyacinth entirely and to remove what is actually a terror for agriculturists in the area commanded by the Nizamsagar canals.

Crop & Trade Report.

Cotton, Raw in the Madras Presidency. The receipts of loose cotton at presses and spinning mills in the Madras Presidency from 1st February 1938 to 17th June 1938 amounted to 242,654 bales o' 400 lb. lint as against an estimate of 488,600 bales of the total crop of 1937—38. The receipts in the corresponding period of the previous year were 296,270 bales. 206,167 bales mainly of pressed cotton were received at spinning mills and 26,776 bales were exported by sea while 56,471 bales were imported by sea mainly from Karachi and Bombay.

(*Director of Agriculture, Madras.*)

College News and Notes.

Students' Corner. The College reopened on the 15th instant and students of the 2nd and 3rd year classes have assembled after the summer vacation.

Personal. On the eve of his departure on leave preparatory to retirement of Sri. K. Krishnamurthi Rao, Assistant Sugarcane Expert, a farewell dinner was arranged on the 28th May 1938 at the Officers' Club. He left Coimbatore on the 1st of June. A large number of his friends, including members of the Sugarcane Station were present at the Coimbatore Railway Station to see him off.

Several friends of Sri. M. U. Vellodi met him on 11—6—38 at a dinner party arranged in his honour on the eve of his transfer to Tellicherry as Assistant

Director of Agriculture. The Managing Committee and the Editorial Board of the Madras Agricultural Students' Union had the pleasure of meeting him at a tea party on the 10th June 1930 in the M. A. S. U. Hall.

Sri V. Ramanathan, Cotton Specialist and the Vice-President of the Madras Agricultural Students' Union who had been to study electro-culture at Mainpuri left Coimbatore on 26th May and returned on 23rd June 1938, The Union is glad that the Madras Government have taken the early steps in the matter of availing itself of the opportunities for study offered by the U. P. Government.

We are glad to learn that Rao Bahadur T. S. Venkataraman, C. I. E., Imperial Sugarcane Expert, has been elected by the Indian Science Congress as its representative at the forthcoming meeting of the British Association for the Advancement of Science to be held in England in 1938.

We are also glad to note that Sri. K. C. Naik, Superintendent at the Fruit Research Station, Kodur, has been selected as a delegate to the International Horticultural Congress to be held this year in Berlin.

Birth-day Honours. We have much pleasure in recording that Sri. K. Ramiah, Paddy Specialist, Madras, now Offg. Director of the Institute of Plant Industry, Indore, is honoured with the title of M. B. E. in the recent Birthday Honours.

Visitors. The Director of Agriculture. Madras returned to the Estate on the 30th May and was camping here till the 6th instant when he left for Tirupur.

Sri. N. S. Varadachari, Parliamentary Secretary to the Honourable Minister for Agriculture and Rural Development accompanied by Sri. Sankerlal Banker of Ahamedabad visited the Institute on the 30th of last month.

The Honourable Minister for Agriculture and Rural Development arrived in the Estate and had a few hours stay on the 2nd instant.

Sri. V. K. Ramaswami Mudaliar, Zamindar of Cheyyur and Honourary visitor to the Agricultural College visited the College on the 28th May 1938.

Dr. Coleman, Retired Director of Agriculture, Mysore, and Rev. A. F. A. Nendoerffer of United Lutheran Church Mission, paid a visit to the Institute on the 10th.

A party of 8 post-graduate students of the Imperial Dairy Institute, Bangalore in charge of Mr. H. C. Verma I. D. D., N. D. D. (Scot) visited the Institute on the 14th June 1938.

The members of the selection committee consisting of Mr. P. H. Rama Reddi, Director of Agriculture, Mr. R. C. Broadfoot, Principal of the Agricultural College (ex-officio), Mr. Mahboob Ali Beg, Mr. N. Ranganadhan, Rao Sahib S. N. Ponniah Gownder and Mr. P. S. Nambiar (non-official members) interviewed here the candidates for admission into the Agricultural College on the 23rd. inst.

Announcement:- Association of the Upper Subordinate Officers. The Secretary of the Association of Upper Subordinate Officers of the Madras Agricultural Department writes:— " The annual General Body meeting of the Association of the Upper Subordinate officers of the Madras Agricultural Department will be held during the ' College Day Week ' about the last week of July 1938. All members who happen to be at Coimbatore at that time are invited to be present for the function ".

Weather Review—MAY 1938.

RAINFALL DATA

Division	Station	Actual for month	Departure from normal @	Total since January 1st	Division	Station	Actual for month	Departure from normal @	Total since January 1st
Circars	Gopalpore	6·4	+4·4	7·9	South	Negapatam	1·5	−0·1	14.5
	Calingapatam	5·0	+2·4	6·3		Aduthurai *	0·2	−1·8	6·5
	Vizagapatam	1·2	−0·8	3·3		Madura	2·0	−0·9	8 5
	Anakapalli *	2 5	+0·1	3·9		Pamban	0·0	−0·8	11·1
	Samalkota*	0·0	0 0	0·0		Koilpatti*	1·9	−0·1	13·9
	Maruteru *	3·0	+1·6	3·0		Palamkottah	0·1	−1·5	13·4
	Cocanada	2·1	+0 1	2·8					
	Masulipatam	4·1	+2·8	4·1					
	Guntur*	1·8	−0·4	1·8	West Coast	Trivandrum	2·7	−5·8	17·1
						Cochin	6·7	−5·0	11·9
Ceded Dists.	Kurnool	1·2	+0·1	2·1		Calicut	7·8	−0·7	18·2
	Nandyal*	0·2	−1·3	0·5		Pattambi *	6·4	+2·3	15·6
	Hagari *	2·6	+0·7	3·8		Taliparamba *	8·9	+6 8	15 2
	Siruguppa*	3·5	+2·0	4·0		Kasargode *	12·7	+2·6	16·4
	Bellary	0·7	−1 3	2·0		Nileshwar*	15 5	+6·3	20·2
	Anantapur	1 9	−0·2	2·2		Mangalore	15·6	+9·4	19·9
	Rentachintala	0·0	0·0	0·0					
	Cuddapah	0·9	−0·7	0·9					
	Anantharaju-pet *	0 9	−0·7	1·0	Mysore and Coorg	Chitaldrug	1·2	−2·9	3·2
						Bangalore	2·4	−3·5	3·3
Carnatic	Nellore	0·8	−0·0	2·4		Mysore	0·3	−7·3	2·7
	Madras	0·1	−1 0	2·1		Mercara	0·8	−4·9	8·3
	Palur *	0 7	−1·2	7·4					
	Tindivanam *	1 6	+0·1	5·3	Hills	Kodaikanal	4.3	−1·7	12·6
	Cuddalore	0·2	−0 5	6·4		Coonoor	0·0	...	...
Central	Vellore	2·0	−0·3	2·4		Ootacamund *	3 5	+1·6	10 4
	Salem	1·7	−3·0	4·2		Nanjanad *	1·8	−0·4	6·7
	Coimbatore	...	−2·4	2·8					
	Coimbatore A. C. & R. I.*	0·2	−3·1	2·4					
	Trichinopoly	2·2	−0 8	4·4					

* Meteorological Stations of the Madras Agricultural Department.

@ From average rainfall for the month calculated upto 1935 published in the Fort St. George Gazette.

Weather Review for the month of May 1938.

A temporary advance of the Southwest monsoon appeared on 12th in the Southwest Arabian Sea and in the south Bay of Bengal and remained active over that region till 14th. On 15th it became weakened in the southeast Arabian Sea. In the south and central Bay of Bengal the monsoon remained active till 20th and later over the region from the Andaman sea to the head of Bay of Bengal till 23rd. On 26th the monsoon again strengthened in the southeast Arabian Sea and appeared on the Malabar coast on 27th where nearly general and locally heavy rain fell.

On 28th a low pressure area formed in the central Arabian Sea and lay off Konkan and Kanara coast on 29th. Later it intensified into a depression with centre at Lat. 16°N, Long. 68°E and remained stationary till 31st.

General and scattered thundershowers occurred on many days of the month in parts of Hyderabad, Mysore, Malabar, Southeast Madras, Deccan and North Madras Coast.

Rainfall was in large excess in parts of Westcoast and Circars while it was in large defect in parts of Carnatic, Central and Southern districts, in Mysore and Coorg.

Chief falls:—

Mangalore	4·8″ on 1st
Nileshwar	5 4″
Kasargod	4·1″ on 27th.
Pattambi	3 4″
Taliparamba	5·1″

Weather report for the Research Institute A. C. R. I.

Report No. 5/38

Absolute maximum	97·8°F,
Absolute minimum	71 5°F.
Mean maximum	95·8°F.
Departure from normal	+1·0°F.
Mean minimum	74·5°F.
Departure from normal	+0·4°F
Total rainfall	0·20″
Departure from normal	3·07″
Heaviest fall in 24 hours	0·10
Total No. of rainy days	2 days.
Mean daily wind velocity	3. 2 M. P. H.
Mean humidity at 8 hours	61·7%
Departure from normal	-9 9%

Summary. Usual hot weather conditions prevailed and there was a marked fall in day temperature owing to the advent of the southwest monsoon in the last week. The mean maximum and the mean minimum were above normal while the mean humidity was far below. The skies were heavily clouded during the first and the last week and least clouded during the second and third weeks. Rainfall totalled 0·20″ and was far below normal by 3·07°. Lightning and thunder occurred on most of the days of the month. P. V. R. & P. G.

Departmental Notifications.

Posting.

Sri G L. Narasimha Rao, Assistant Agricultural Demonstrator, is posted for work in the Vuyyur Sugar Factory area.

Transfers.

Name of officers	From	To
Sri K V. Gournagamurthi	A D. Atmakur	A. D. Samalkota.
,, D. Achutharama Raju	A. D. (On leave)	A. D. Kandukur,
,, V. G. Venkataramana Rao	A. D. Kandukur	A. D. Ongole.
,, A. Ramadoss	Offg. Asst. in Cotton, Coimbatore	A. D. Bellary.
,, M. Subramania Chetty	Offg. Asst. in Cotton, Coimbatore	A. R. S. Nandyal.
,, G. Konda Reddy	Offg. Asst. in Cotton, (On leave)	A. D. Koilkuntla
,, S. V. Ramachandran	A. D. Mudukalathur	A. D. Tenkasi.
,, Bennet P. Masilamany	A. D. (On leave)	A. D. Tirupathur.

,, N. Annaswami	A. D. Tirupathur (Ramanad)	A. D. Nandigama.
,, C. Jagannatha Rao	Gazetted Asst. in Cotton Scheme, Coimbatore	Asst. in Cotton, A. R. S. Nandyal.
,, P. Satyanarayana	A. D. Kadiri (On leave)	A. D. Markapur.
,, D. Panakala Rao	A. D. Nandigama	A. D. Bezwada.
,, C. Bhujanga Rao	A. D. Ananthapur	A. R. S, Anakapalli.
,, V. S, Rangacharlu	A. D. Cuddapah	A. R. S. Guntur.

Leave.

Name of officers	Period of leave
Sri K. V. Gourangamurthi, A. D., Atmakur.	Extension of l. a. p. for 23 days from 21—5—38.
,, K. Sivasankara Menon, A. D., Perintalmanna.	L. a. p. for 1 month from 5--6—38.
,, G. Konda Reddy, Offg. Cotton Assistant, Nandyal R. S.	L. a. p. for 1 month from 13—6—38.
,, A. Ramadoss, Offg. Cotton Assistant.	L. a. p. for 1 month from 1—6—38.
,, D. Panakala Rao, A. D., Bezwada.	L. a. p. for 1 month from 1—6—38.
,, L. Narasinga Acharayar, A. D., Tonneri.	L. a, p. for 1 month from 25—5—38.
,, M. R, Balakrishnan, Asst. in Chemistry, Coimbatore.	Extension of l. a. p. for 1 month from 1—6—38.
,, P. K. Kunhiraman Nambiar, A. D , Satur.	L. a. p. for 2 months from 1—6—38.
,, M. Somayya, F. M. A, R. S., Nandyal.	L. a. p. for 1 month from 1—6—38.
,, D Bapayya, A. D,. Bezwada.	L. a. p. for 1 month from 1—6—38.
,, M. U. Kondal Rao, A. A. D., Vinukonda.	L. a p. for 1 month from 18—5—38
,, T. Seshachalam, A. D., Ongole.	L. a. p. for 2 months from 25—5—38.
,, L. K. Narayana Ayyar, A. D., Shiyali.	L. a p for 1 month from 26—5—38.
,, M. Narasimham, A. D., Guntur.	L. a. p. for 22 days from 9—5—38.
,, S. Venkatarama Ayyar, A. D., Conjeevaram.	L. a p. for 2 months from 25—5—38.
,, R. Venkatarama Ayyar, A. A. D., Vridhachalam.	L. a. p. for 1 month from 2—6—38.
, A. B. Adishesha Reddy A D., Tadpatri.	L. a. p, for 2 months from 21—4—38.
,, N. Annaswami, A. D., Tirupathur.	L. a. p. for 1 month from 9—6—38.
,, A. K. Ganesa Iyer, A. D., Paramakudi.	L. a. p. for 3 months from 23—5—38.
Mohammad Ali Sahib. A. D., Puthur.	L. a. p. for 2 months from 19—5—38.
U. B. Mohammad Abbas Sahib, A. D , Tirupathur (N. A.)	L. a. p. for 1 month from 9--6—38.