https://doi.org/10.29321/MAJ.10.A04912

sown separately. At harvest time it was noticed that in both of them there were both kinds of seeds. This difference in colour is thus traceable to differential environment during the ripening of seeds.

The rarer seed-coat colours are (1) black, (2) black-mottled, and (3) black-patchy. The black-mottled seed consists of both chocolate and brown seed coats dotted over with black dots. In the case of the black-patchy, the seed has black patches on the seed coat, the black-free regions being mostly along the rim of the seed. The black seed is completely black. Crops from black coloured seeds have a tendency to be shorter in duration and a little less vigorous than crops raised from the more common brown seeds. In the varieties examined, it is noticeable, that black seeds, entire or mottled, appeared only on P_1 plants.

References.

Benson, C. (1879). Dolichos biflorus—*Saidapet Experimental Farm Manual and Guide.*

„ (1885). Dolichos biflorus—*Records of the Saidapet Experimental Farm.*

Chandrasekharan, S. N. and Ramakrishnan, T. S. (1928). *Jour. Madras Agr Stu. Union,* Vol. XVI. p. 281.

Church, A. H. (1886). Dolichos biflorus—*Food Grains of India.*

Duthie and Fuller. (1893). Dolichos biflorus—*Field and Garden Crops of North West Provinces and Oudh.,* Part III, p. 2.

Watt, G. (1890). Dolichos biflorus—*Dictionary of Economic Products,* Vol. III, p. 175.

„ 1908. *The Commercial Products of India.*

THE PRESENT POSITION OF THE COTTON STEM WEEVIL PROBLEM*

BY K. DHARMARAJULU, M. Sc., M. SURYANARAYANA, M. Sc.,
E. R. GOPALA MENON, M. A. and V. MARGABANDU, M. A.,

Agricultural Research Institute, Coimbatore.

Introduction. *Pempheres affinis* or the cotton stem weevil, as a pest of indigenous and exotic cottons is of considerable importance in South India. It is not definitely known when and how this pest was introduced into this country; in fact it is even difficult to say whether it is one of the introduced forms at all; although the nature of its scattered and somewhat isolated distribution would appear to indicate its exotic origin.

When first noticed in South India it was found to be confined to the Coimbatore district and to the Cambodias in particular. Since then, it has spread to almost every cotton-growing centre of the Presidency and to all types of cotton.

* Paper presented at the College Day and Conference, October 1933.

These facts point to the necessity for the control of the pest and it is proposed to present in this paper, the present position of this aspect of the *Pempheres* problem in so far as it is revealed by studies of the bionomics, habits and life-history of the insect.

Life history:—The life-history of the insect has been worked out in some detail by Ramakrishna Ayyar [2] and has been confirmed, with some minor differences by Ballard [1]. Studies made during the last two seasons are largely in a line with these findings and briefly stated are somewhat as follows:—

The adult *Pempheres* lays its egg in a small cavity made for the purpose opposite to the medullary rays, preferably on the hypocotyl regions of the cotton plant, and covers it up with a gummy exudation secreted from its body; and at this early stage in the life of the insect, begins the association between the plant and the insect which is in every way advantageous to the latter and disadvantageous to the former and is ended in most cases only by either the death of the plant or the successful emergence of the young adult. After hatching out from the egg, the young larva cuts its way through the medullary ray and thereafter tunnels round the stem along the cambium taking a slanting and downward course and feeding on the soft portions as it goes along. It then scoops out a pupal chamber in the wood and emerges when ready, by cutting through the bark at the other end. The plant, on the other hand, seldom puts up anything like an aggressive fight and tries to escape death only by increasing its out-put of building material and in spite of the best it could do, often succumbs with all its wealth of flowers and bolls to mechanical disturbances like high winds.

A consideration of facts led the earlier workers to suggest the adoption of long close periods as a preventive measure, the enforcement of which was attended with very many complications. More detailed studies of the life-history of the insect and of the progress of infestation have furnished fresh lines of attack.

It is not proposed to deal with all the aspects of the problem that were investigated but only with such of those as have been suggestive of the possible means of controlling the pest and this is perhaps best done along with a consideration of such measures as formed the subjects of these investigations.

1. Biological Control. This has in recent years met with a large measure of success in the case of certain pests and is rather popular with entomologists because of its cheapness and easy applicability. With regard to stem weevil, two methods of biological control seem to be feasible.

Firstly during the examination of the larval burrows a few dead grubs were obtained that had been parasitized by fungus. This suggested the idea of the utilisation of such fungi for the control of the insect. Isolation of these parasitic organisms was then made from the dead grubs and the affected stems by the usual methods of repeated subcultures and finally by the single-spore method. Four forms of fungi were thus isolated and their pathogenicity was established by parasitisation experiments and reisolation of the fungus from the affected grubs. The method adopted for utilising these fungi for the control of the pest, consisted in periodically spraying the plants with an aqueous suspension of the spores of the most virulent of the four forms isolated. The other method is the common one of using parasites. Unfortunately very few insects, have so far, been found parasitising the weevil. Two chalcids were discovered feeding on the larvae. Experiments are, however, under way to observe if any useful parasite can be found. Incidentally it might be remembered that this pest is found to be rare in parts of Tinnevelly, Madura and Ramnad districts. It is proposed to study the conditions that have engendered this happy state, and if any clues are available, they will be tested at the Cotton Breeding Station, Coimbatore, to determine their applicability.

2. **Utilisation of the defensive mechanisms of the plant.** As already mentioned the habit of the larvae precludes the use of insecticides. In their absence one naturally has to turn to the plant for such mechanisms as it may possess which might cause the insect to avoid such plants. It is surprising to note that all the varieties of cotton studied at Coimbatore are susceptible partly or wholly. The few plants that look free have shown themselves later on as mere escapes. The next useful item is the selection and isolation of resistant and tolerant types.

An examination of the attacked portions of the plant showed that by far the most important characteristics in the present case, are the hairiness, gum and gall-formation. Of these, however, gall-formation is far from being a reaction of an aggressive type. It is only a way to set right the damage before it proves fatal. Failure to form galls at the early stages in the life of the plant, has been found to be one of the sure causes of its death when attacked, and such measures as would enable the plant to form galls even at these early stages should help to reduce the mortality due to the infestation. Experiments are in progress to study if this characteristic is heritable.

"Hairiness" of plant organs is often connected with direct resistance. In the case of *Pempheres* the preference of the non-hairy part of the hypocotyl regions for egg laying seemed to point to this suggestion.

In an examination of a large number of varieties, it was found that Gadag I alone has a hypocotyl, the upper 2/3 of which is pubescent; and in all varieties there is generally a thick coat of hairs only above the cotyledonary node. By earthing up to the cotyledonary node, the non-hairy part is prevented from being attacked and the above-ground parts would then all be hairy so that the insect would find it extremely difficult to infest. Field trials gave not too discouraging results. Experiments are in progress to breed a Cambodia with a pubescent hypocotyl.

Some of the plants have the capacity of producing quickly a gum-like substance in the wounds, which if produced profusely imprisons the grub or the emerging weevil from being a future source of infestation. Attempts are being made to evolve a type possessing this defensive trait.

3. Artificial Methods. In the course of these studies, it was considered that, although the insect was capable of attacking any cotton plant and under all conditions, the severity of the attack might vary with the environment. A definite correlation between these or their easily reproducible combinations and the incidence, should if established, lead to a better understanding of the controlling causes and the formulation of more effective measures of checking the pest.

With this idea in view, a number of agronomic experiments were conducted to study the influence of rotation, irrigation, manuring, spacing and the systems of cultivation on the incidence. The results of these experiments are summarised in the following table.

Percent of Pempheres Attack in 1. Spacing, 2. Manurial, 3. Rotation and 4. Irrigation Experiments.

(1932–33).

No.		Treatment.		% of attack.
I		**Spacing**		
	1	Control	3′ × 9″	50·1
	2	Spacing close	3′ × 4″	45·5
	3	Flat Beds		56·0
	4	Spacing between rows	2′ × 9″	52·4
II		**Manurial**		
	1	Control (Farm Yard Manure)	5 tons.	72·7
	2	Potassium sulphate	2 cwts.	71·4
	3	Gypsum	5 cwts.	70·6
	4	Farm yard manure	10 tons.	73·2
III		**Rotation**		
	1	After Cholam		81·31
	2	,, Ragi		77·69
IV		**Irrigation**		
	1	Dry		63·61
	2	1 week		46·01
	3	2 weeks		53·3
	4	3 weeks		51·4

In the case of the 4″ spacing experiment, the incidence was found to be significantly less. This is rather interesting in that it affords a confirmation of the effect of light. In the life-history studies made, it was observed that the greatest emergence takes place during the hottest part of the day and the insect invariably shows definite heliotropic tendencies. This perhaps is responsible for the crowding of the insects under the open conditions of the field to the wider spaced, and therefore better lighted portions of the field. This might also mean that when the plants are crowded, the micro-climate amidst them might not be suitable for its development. But experiments tried to test the limits of humidity within which the insects might thrive best, signified that they could stand both the maximum and minimum humidities.

It is interesting to observe that the adults, pupae and larvae shrivelled up soon, when the green stems were dried immediately. If the plants are pulled and sundried individually for seven days, there is no chance for any insect to emerge out of the stalks. This measure along with the close spacing seemed to be very hopeful

4. Indirect Methods. The suggestion for a long close period as an effective method of starving out the pest had been recommended, and tried, but it was far from being an unqualified success due to various reasons. This unfortunate result is largely due to the apathy of the ryots.

It has been found that the life period of the insect is about 3½ months at its maximum which is itself a little too long to be practicable. Added to this, is the ability of the *Pempheres* adult to live on plants other than cotton and these are neither few nor uncommon. The only feature that makes a measure of control such as this, somewhat hopeful is, that the insect as far as our experiments go, is unable to breed, leaving a few *Corchorus* plants, on any plant other than cotton.

Under these circumstances, the only hope of exploiting to the full, the use of this specific relationship of the cotton plant to the density of the insect population, lies in shortening the growth period of cotton so as to enable two early harvests to be had. Two lines of work are being pursued towards this end. One is vernalisation and the other is breeding of early varieties.

Based on Lyssenko's observations that growth is distinct from development, the process of vernalisation consists in temporarily keeping growth in check and in subjecting the germinating seeds to the influence of factors like darkness, humidity, aeration and temperature that favour the reproductive development. With the transfer of the seeds thus treated to proper conditions of growth, it is claimed that the period of vegetative growth is shortened and that there is saving in the time ordinarily taken by the plant to pass from the growth to the developmental or reproductive phase.

The details of the technique are given in (Bull. No. 9, I. A. B. 1933) and consist in giving the seeds the amount of moisture just necessary for embryonic development and exposing them to the intense conditions necessary for the progress of the reproductive phase. It is hoped by such means to materially shorten the growth of cotton so as to ensure a sufficiently long close period.

The other method is to breed by hybridisation, a type of American cotton which will give the two pickings before the 15th May. Fortunately Uganda cottons are found to be the earliest of American cottons. When crossed with Co. 2, some of the plants in F_2 population portended to produce types which will come up to our ideals. Progenies of the promising cultures are in the F_3 generation at present.

In conclusion it may be said, the lines on which we propose to proceed for solving the *Pempheres* problem are:—

1. The production of early types of cotton which would enable us to observe a long close period.
2. The evolution of selections which will not permit the insect to breed in the plant.
3. Isolation of types that will get over the injury done by the insect very quickly.
4. Recommending the adoption of such agricultural practices which will considerably reduce the surviving insect population.
5. Detection of parasites that will effectively keep the insects under control during their developmental phase.

Acknowledgement. The authors are indebted to the Indian Central Cotton Committee, Bombay, for financing the Pempheres & Physiological scheme, under which the work outlined above is being carried out. Thanks are also due to the Cotton Specialist, Agricultural College, Coimbatore, for the many helpful suggestions given during the progress of the work.

References.

1. Ballard E. (1922) *Mem. of Dept. Agr. in India* Ento. Series. Vol. VII: 243—255, 1922.
2. Ramakrishna Iyer, T. V. (1918) *Madras Agr. Dept. Year Book* 1—13.

THE MANGO FRUIT PRESERVE

BY K. RANGASWAMI, B. Sc. Ag.

Village Investigator, Narasapatam

The mango fruit is admittedly the best of all fruits. Containing the vitamins necessary for proper nutrition, the fruits may be eaten in plenty. There is a method of drying the fruit juice by which surplus fruits could be utilised during seasons of plenty. This mango fruit-preserve has many virtues of the fruit. There is no satisfactory device known to garden-owners for preserving the fruits,