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Some experiences with Gammexane (BHC) and DDT in the control of crop pests

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The Entomological section has been engaged for some time in studying the effect of the two new insecticides Gammexane (B.H.C.) and D. D. T. on a wide range of crops and pests. The results in most cases have been far beyond expectations. In fact some of the tentative data have been so convincing in the case of a number of major pests like the paddy grasshopper *(Hieroglyphus banian)*, the paddy jassid (*Nephotettix bipunctatus*), the paddy swarming caterpillar *(Spodoptera mauritia)*, the rice bug *(Leptocorisa acuta)*, etc., that the information could be passed on straight away to the ryots even without any further confirmatory tests. What is more interesting is that the two chemicals appear to have a definite selective action, each being effective only against a certain group or category of insects. The response from the ryots also has been very encouraging as a keen demand for these chemicals has now sprung up from farming public. These trials have revealed the possibilities of warding off the damage by many a crop pest, control measures for which were till now either imperfect or non-existent. The insecticides, apart from their high potency, are fairly cheap and easily available with some of the local firms.

I. *Amsacta albistriga— The red-hairy caterpilllar.* This is one of the serious pests of dry crops and is prevalent in most of the dry red soil tracts of this Presidency. The full-grown larvæ are about 2" in length, red in colour with a hairy body. They are polyphagous in habits and capable of thriving on anything green but rainfed crops like groundnut, cumbu, cotton, sometimes cowpea, castor, cholam, etc., are some of the worst affected. In the absence of cultivated crops they freely take to wild vegetation such as Jatropha, Calotropis, Tridax and sometimes even grasses. In cases of severe infestation, millions of these caterpillars occur in definite broods and march from field to field leaving a trail of destruction behined.

Life-history. The life-history ol this pest is briefly as follows. Heavy infestation of the caterpillars occurs generally after the South-West monsoon in July and continues upto September in two or three distinct waves. The full-grown larvae seek shady places under trees, or hedges, sandy corners of fields, etc., to pupate. They burrow under to about 6" in the soil, excavate small oval chambers and line the sides with their own hairs woven together with silken threads. They subsequently cast off their skin and turn into dark brown pupae which remain quiescent till the next season. With the receipt of the first summer showers during the next May or June, the contents of the pupae which are first in a liquid

condition, transform themselves into the shape of the adults, the pupal skin gets soft and the moths are thus ready to come out of the soil at the next opportunity. With the Moistening of the soil after the next sharp shower, they wriggle out of their shells and burrow their way up with the help of the two spurs provided on the first pair of legs. Over 10,000 moths have been observed to emerge within a limited area of about 10 sq. yards in the course of a couple of hours. The emergence commences exactly on the third evening after a shower by about 5 P. M. and may continue till late in the evening. The moths begin mating very soon and lay hundreds of creamy, white eggs in masses the same night anywhere on the soil, clods of earth, pieces of stone, etc. When there is a standing crop, the lower surface of the leaf is preferred for egg-laying. Individual females have been recorded to lay 800 to 1,300 eggs in the course of three days and the average capacity may, therefore, be computed to be a thousand. Tiny dark-coloured caterpillars hatch out in the course of three to four days and live gregariously for a similar period scraping and feeding on the green matter from the leaves. They gradually increase in size as they feed and restrict their activities to the neighbouring plants for about ten days. By this time they are ashy coloured and about ¾" in length and the real trouble starts from this stage. They develop a voracious appetite showing a special partiality for the flowers and begin to disperse generally in particular directions. They march on from field to field devouring all vegetation and develop the characteristic reddish colour in about 20 days and get fullgrown to a length of about 2" in another ten days. On receipt of the next heavy showers and the consequent wetting of the soil, they again seek favourable spots, burrow down to pupate and emerge as adults in the next season. The number of emergences during a particular season corresponds to that of the different broods of the caterpillars which had gone down to pupate during the previous year.

Habits, nature and extent of damage, etc.: The natural habitats of this pest being essentially the dry red soil areas, a periodical rainfall is necessary for the progress of the host crop as well as for the proper development of the pest. The failure of the thunder showers for long periods after the sowing not only affects the growth of the young crop but also renders the soil too hard for the moths to emerge from below. Secondly, if the rains fail again at the time when the caterpillars are full-grown and ready to pupate they are unable to burrow into the soil, which is quite hard when it is dry. The caterpillars stop feeding, wander about aimlessly in search of suitable places for pupation and ultimately die in their millions. Instances have been noted where scores of the carter-pillars were struggling to get into the soil round about smalls pots moistened by the exudation of the plant sap from roots of trees, which were cut accidentally. There are a few other aspects in the habits of the pest which are worth mentioning here. In South Arcot, where the sun is

particularly severe during June and July, emergences taking place before the sowing of the crop are capable of little or no damage. The summer showers do effect enormous emergences but the moths lay their eggs anywhere on the soil, weeds, pieces of stones, etc., and the eggs as well as the young caterpillars, if the latter manage to hatch out, perish either due to extreme heat or want of food and it is only the subsequent emergences which are of any serious consequence. On the other hand, conditions are different in tracts, where the climate is mild as in Punganur, etc., situated in the Mysore Plateau. Moths emerging with the sowing rains lay their eggs on the soil, weeds, etc., and the young caterpillars on hatching infest the tender germinating dry ragi crop. Sprouting young seedlings of other dry crops like cotton also share a similar fate. While a severe loss is inevitable in cases like germinating ragi, cotton, etc., and in cumbu, were the entire flowers are eaten, the damage is not so serious on groundnut which is more hardy and capable of recovering after the next rain. Another interesting point is that fields where there have been heavy emergences of the moths suffer very little from the pest for the reason that the caterpillars invariably disperse by the time they attain the damaging stage.

Control measures in vogue: So far a systematic hand-picking of the moths as they emerge and subsequently the egg-masses, young caterpillars and later the grown-up ones as well is in practice. The overall cost of the operation worked out to Rs. 2/- per acre and the money value of the additional yield according to the prevalent rates was Rs. 25—8—0 in the case of mixed cumbu and Rs. 52—8—0 in the case of groundnut. A common practice of digging trenches across the line of progress of the caterpillars is also in vogue to prevent their spread from the infested fields to fresh areas. Light traps have been found to attract the moths in very large numbers, but the majority were only males, the number caught being directly proportionate to the intensity of the light.

Work done: *Insecticidal trials — material and methods:* A report was received from the Assistant Cotton Specialist, Adoni during 1948 about the severe incidence of the pest on cotton seedlings, frequently necessitating a resowing of entire areas and about the spectacular effects he had by spraying M.K.E. — D.D.T. emulsion at 1·25%. The present experiments were taken up at Adoni during July, 1949 to confirm the above results and also to see whether the treatments could be simplified. DDT and BHC were tried as dusts and sprays and the DDT emulsion as spray only. The experiments were conducted in plots 28′ × 28′ replicated four times with adequate controls. The concentrations used were (1) 3, 4 and 5% dusts of the two chemicals, (2) Sprays of DDT at 0·1% and 0·25%, (3) of Gammexane P. 520 at 0·05% and 0·1% and (4) 0·16, 0·32, 0·48 and 0·64% (1 to 4 ozs. in a gallon of water) of the kerosene emulsion. The aqueous spray of DDT at 0·1% was not found effective at the first instance

and as such the next higher dosage of 0·25% was tried. The dusts and sprays were applied in the field with the requisite appliances, the quantity being approximately 30 lb. per acre in the case of the dusts and 30 to 40 gallons in the case of the spray fluid. The two chemicals (5%) strength were also applied in trenches dug across the line of progress of the caterpillars and the results of the contact with the chemicals observed. The effects in all these cases were assessed twenty-four hours after the treatments by taking counts of the dead caterpillars. It has, however, to be admitted that in the case of these active creatures which are always on the move, certain allowances have to be made for the invaders from outside as well as the escape of the treated larvae to other areas. The figures as such cannot, therefore, claim a very high degree of accuracy but this defect has been a common factor in all the treatments. The percentages of mortality may, therefore, be taken as indicative of the repective efficacy of the different chemicals. The data of the treatments were analysed statistically and the figures are furnished in the statement No. 1.

Results: *Dusts — DDT 3, 4, and 5%*: The application of the dusts under the local conditions appears to have some limitations. The cotton plants were about 3 to 4 inches in height with a few leaves and as such a thorough treatment involved in an inordinate waste of the material, the high winds prevalent at the period aggravating the trouble. The mortality figures also were not very convincing as the mean averages ranged from 17·75 to 39·00%.

(b) *BHC 3, 4 and 5%*: The same limitations were applicable in this case also but the mortality was more encouraging as it ranged from 26·75 to 48·00%, the highest being in the case of 5% BHC.

Sprays: (a) *DDT*: In spite of the fact that the plants were drenched with the caterpillars *in situ*, the mortality recorded was only 50·75% in the case of 0·1%.

(b) *BHC*: The results in this case were better as a higher mortality of 60·75% and 63·25% has been recorded for the 0·05% and 0·1% concentrations respectively.

(c) *DDT kerosene emulsion. (0·16, 0·32, 0·48 and 0·64%)* The results in this case also are not very convincing since the means ranged from 28·5% to 38·5%.

Exploratory trials were conducted to study whether the emulsion has any phytocidal action. Different concentrations from 0·16, 0·32, 0·64, 0·96, 1·27 and 2·56% of the emulsion were sprayed on a week-old Karunganni and Cambodia seedlings. The results indicate that the last mentioned three strengths caused an almost immediate withering of about 75% of the plants, which completely dried up in the course of three days Cambodia being more susceptible. The lower dilutions at 0·32 and 0·64% although not so fatal, were still found to cause about 10% mortality. Most of the surviving plants showed definite symptoms of scorching. Leaving

aside the phytocidal risk, the ingredients of the emulsion are beyond the reach of the ordinary ryot both by way of their high cost as well as their non-availability.

Trenching: Trenches about 9" wide and 1' deep and 20' long were dug across the direction of the progress of the caterpillars and one pound of the 5% concentration of each of the chemicals was applied in four replications. The effect of the contact of the chemicals on the caterpillars which had dropped in the trenches in their onward progress was observed after 24 hours. The mortality figures are 62% in the case of DDT and 86·5% for BHC. From general observations, the chemicals appear to have a quicker knock down effect on the younger stages as a good number of them were found dead in the trenches themselves, while the full-grown ones died more leisurely in the field after crossing the barrier.

Conclusion: Both BHC and DDT definitely indicate their lethal action against the caterpillars by contact. The first symptom of discomfort is perceptible in about 6 hours when the caterpillars get moribund and lie curled up, neither moving nor feeding and the actual death takes place in about 24 hours. The young caterpillars appear to be more susceptible. Between the two chemicals, DDT both as spray and dust appears to be slow in action, while BHC is quicker.

Taking into consideration, the previous experience and the current data on hand, it still looks as if the time-honoured method of prompt hand-picking of the moths and the other stages is the simplest and most efficient. While dealing with pests as the present one, the local conditions as well as the human material deserve the first consideration before advocating any new method. The ryots of these tracts are proverbially poor and any method involving even a small expenditure is not likely to have a warm reception. But with the present attractive prices of agricultural products, high cost of labour and the consequent insecticide-minded attitude of the ryots, it is likely that this chemical warfare might find favour with them. In experimental stations, where the valuable strains of plants have to be saved at any cost, the treatment is well-worth the trial. Discussing the relative merits of the different preparations BHC P. 520 sp[illegible] at 0·05% was quite effective. The quantity of the spray fluid required and the consequent cost of the application naturally depend upon the severity of the incidence. One and a quarter ounces of the chemical have to be dissolved in a gallon of water to give the above concentration and the cost of the same works out to annas 2/-. For reasons already mentioned, it is not considered desirable to advocate the use of either the dusts or DDT emulsion.

The experiments were conducted by Messrs. T.S.Muthukrishnan, Assistant in Entomology and M. Ranganathan, Fieldman, with the kind facilities provided by the Assistant Cotton Specialist, Adoni.

STATEMENT I. Percentages of Mortality

No.	Treatment	Replications				Total	Mean
		I	II	III	IV		
1.	DDT 3% ...	32	32	32	20	117	29·25
2.	DDT 4% ...	15	25	20	11	71	17·75
3.	DDT 5% ...	72	38	14	32	156	39·00
4.	DDT 0·1% spray ...	61	59	40	43	203	50·75
5.	DDT 0·25% spray ...	36	60	27	57	180	45·00
6.	BHC 3% ...	39	36	36	15	126	31·50
7.	BHC 4% ...	17	38	35	17	107	26·75
8.	BHC 5% ...	70	59	33	30	192	48·00
9.	BHC 0·05% spray ...	67	67	50	59	243	60·75
10.	BHC 0·1% spray ...	59	77	80	37	253	63·25
11.	MKE Emulsion—1 oz. in 1 gallon of water ...	23	36	36	19	114	28·50
12.	MKE Emulsion—2 ozs. in 1 gallon of water ...	25	25	32	31	113	28·25
13.	MKE Emulsion—3 ozs. in 1 gallon of water ...	57	55	17	25	154	38·50
14.	MKE Emulsion—4 ozs. in 1 gallon of water ...	25	43	17	31	116	29·00
15.	Control ...	13	6	6	6	31	7·75
	Total ...	612	656	475	433	2176	544·00

Conclusion

10 9 4 8 5 3 13 6 1 14 11 12 7 2 15

STATEMENT II. Average percentage of mortality in trenches

No.	Treatment	Replications.			
		I.	II.	III.	IV.
1.	DDT 5%	56·6	48·6	67·6	73·3
2.	BHC 5%	64·6	30·6	66·0	72·0
3.	Control	23·3	8·3	16·6	8·3