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The Fluted Scale, *Icerya purchasi* Mask., as a Pest of Wattle in South India, and its control by the Biological Method (Contd.)*

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The Importation of the Predator Beetles As it became evident that a control of the pest by mechanical or chemical means was neither economical nor efficient, it was decided to try the biological method, and entomologists of various countries where the Australian ladybird beetle was known to be existent either naturally or after introduction, viz., Ceylon, Queensland, New South Wales, Victoria, South Australia, Java, South Africa, Kenya, Rhodesia and Egypt were addressed in April—June, 1928, requesting supply of *Vedalia* beetles for fighting the Fluted Scale in this province. In addition, the Director, Imperial Institute of Entomology, London was approached with a request for arranging supply of live predator beetles from France or elsewhere. There was prompt response from many of these countries, but most of them expressed their inability to send an immediate supply owing to the scarcity of the scale and its predator, especially in the case of the countries of the Southern Hemisphere, where winter was then prevailing. It was not till May, 1929 that the first supplies of beetles were received, and after breeding and multiplying the scanty supply received the first batches of beetles could be liberated in infested areas only in August, 1929. Altogether three consignments of *Vedalia* beetles were received from abroad, the first from South Africa, the second from California through the Farnham—Royal Parasite Laboratory (both in May, 1929) and the third from Egypt in January, 1930.

The first consignment On 26th April, 1929, the Chief Entomologist, Union of South Africa, Pretoria cabled information about the despatch of live Vedalia material collected from Port Elizabeth (Cape Colony) and shipped from Durban on the 20th April, on board S. S. *Gujarat* of the Indian and African Line for Madras. The consignment was received at Madras on 9th May, by one of the authors (Cherian), but unfortunately, it was found when the parcel was opened that the contents—about 106 beetles—were all in a dead condition. It was surmised that this disaster could have been prevented if more food-material had been provided for the beetles and arrangements made for keeping the parcel in cold storage during the voyage. Further supplies of beetles were cabled for from South Africa, but could not be obtained as winter had already set in by then.

* Continued from Vol. XXXII., Page 102.

The second consignment In response to a letter of enquiry, Dr. G. A. K. Marshall, Director, Imperial Institute of Entomology, London wrote in February 1929 to the effect that arrangements had been made with Dr. Paul Marchal for collecting Vedalia material from the south of France in June, but in the mean-while, as a consignment of beetles had been obtained from California, Dr. W. R. Thompson of the Farnham-Royal Parasite Laboratory cabled information as to its despatch on board S. S. *Morwuda* sailing from the Royal India Docks, London on the 20th April and due to reach Colombo on the 16th May. The parcel was duly taken charge of at Colombo directly from the vegetable cool room of the steamer, on 16th May by Mr. T. V. Subramaniam, Assistant Entomologist, sent from Coimbatore, and on opening it out, three live beetles and about half a dozen grubs were found alive, though as many as 84 dead beetles were also seen among the contents. The live ones were fed at once on Icerya scales brought from the Nilgiris, and incidentally, a few grubs of the Vedalia beetle were found in a small parcel of Icerya bugs collected from infested wattle at Newera Eliya through the kind offices of the Director of Agriculture, Ceylon for the purpose of feeding the beetles on arrival. All this live material was brought without delay to Coimbatore on 18th May, and despatched the very next day to the breeding laboratory opened at Keti (6,800 ft.) on the Nilgiris.

Breeding Work at the Laboratory at Keti Out of the various centres of Icerya infestation on the Nilgiris, Keti was selected for locating the breeding laboratory on account of its central situation, its easy accessibility by rail and road and the existence of a post office, besides the availability of ample food material there for feeding the beetles. The laboratory was fitted up in a rented bungalow and was placed in charge of an Assistant.

Although the stock with which work was started was very meagre, consisting as it did on 19th May, 1929 of 3 beetles and a score of grubs, it proved to be sufficient for securing successful results The grubs throve well in cages, pupated normally and emerged as adults, and the beetles paired freely and laid eggs, which hatched in 7 to 9 days into active grubs. By the first week of June, there were about a dozen beetles laying eggs, about 100 grubs and pupae besides scores of eggs. By the end of July, the stock had increased to about 380 beetles, 350 pupae, about 5,000 grubs and probably as many eggs. Encouraged by the multiplication thus effected and taking advantage of a break in the monsoon, a small batch of beetles was liberated at Aravankadu in August 29 and another, a week later, on Mr. Parry's estate at MacIvor's Bund. During September 1929 further releases were effected at Fairlawns, Aravankad and Bandyshola near Coonoor. Observations made periodically at the places of liberation showed that the beetles were breeding in nature, fresh eggs and grubs being noticeable, in spite of rather adverse weather conditions. With the advent of the North-east monsoon in the middle of October, however, conditions were found to have become very unfavourable for the breeding of ladybirds in nature.

In the laboratory also, a setback was noticeable, which almost threatened to bring the breeding work to a standstill. The beetles in cages exhibited low vitality and large numbers of grubs were found dying. This was at first attributed to the evil effects of in-and-in breeding, and to a certain extent it appeared likely that the setback was partly the result of competition for food from the local predators—*Rodolia roseipennis* and the *Stathmopoda* caterpillar—introduced from the field along with the scales. After careful examination, Mr. S. Ramachandran, who was then in charge of the laboratory, came to the conclusion that the fall in the rate of breeding was mostly due to the general lowering of temperature and the rise in humidity associated with the North-east monsoon. By artificially raising the temperature of the breeding room at night by keeping a lighted Petromax lamp, as well as by selecting scales free from other predators for feeding he was able to overcome the set-back, so that by February 1930 the rate of output of beetles was again satisfactory.

The third consignment (Obtained from Egypt in January 1930). In reply to a request for a supply of Vedalia beetles made in September, 1928, Mr. E. Ballard, Chief Plant Pathologist, Cairo (who was formerly Entomologist at Coimbatore) wrote to say that although *Vedalia* had been introduced years ago for controlling *Icerya purchasi* and *I. egyptiaca*, its distribution was very uneven and that it was proposed to breed the beetles in large numbers and redistribute them about the country. Reminded again in April, 1929, Mr. Ballard intimated in November 1929 that he was in a position to send a consignment by air-mail. After further correspondence, the *Vedalia* consignment was, by previous arrangement, despatched by air on 9th January, 1930 from Cairo to Karachi, where by the kind co-operation of the Deputy Director of Agriculture, Sind, it was booked by rail immediately on receipt on the 13th January to Coimbatore, as at that time there was no air-mail service to Madras. The journey by railway took a much longer time than anticipated and the parcel reached Coimbatore only on the 21st January. According to advice received from Cairo, the consignment consisted of 500 larvae, 150 pupae, 150 adults, and when opened out at Keti on the 23rd January, the contents were reported to be about 152 grubs, 196 pupae and 204 beetles, with 73 dead beetles in addition. The box in which the live material was sent had been divided into 3 compartments by partitions so as to restrict knocking about during transit, and plenty of food-material had also been provided. The pre-eminent success of this consignment should be attributed to (1) the comparative quickness of the transit (part of which was by air), (2) the presence of abundant food during voyage, and (3) the prevalence of cold weather conditions during most part of the journey, Cairo to Poona, at least.

Release of Predator Beetles on the Nilgiris As already mentioned, the output of beetles was again on a satisfactory basis at the Keti laboratory by the end of January, 1930, and the receipt of the fine consignment from Egypt at this juncture proved to be a very valuable augmentation of the stock available for breeding and distribution. A periodical release of the Vedalia beetles was, therefore, once again taken up, and between February and October, 1930 nearly 4,000 beetles were on the whole, liberated in various infested areas ranging in numbers from 100 to over 600 every month. The following were the main areas of liberation: (1) The Avalanche Road area: Fairlawns, Nanjanad, Porthi, Hookaradai, Avalanche etc., (2) The Ootacamund area: Bishop's Down, Marlimund, Kandal, Club Road, Tiger Hill, Jackal Hill, Kilkavatti etc, (3) Ketti area: Keti, Aravangad, Wellington, Katteri, Osatti, Hookabetta etc., (4) Coonoor area: Coonoor, Bandishola, Springfield, Jakatala, Banniway, Ottanhatti, Idappalli etc., & (5) Kotagiri area: Kotagiri, Kodanad Road, Convent Orchard, Cockburn Road etc., Usually adults were set free at the places desired to be controlled, but in some cases infested twigs containing eggs and grubs of Vedalia were taken from the cages and tied up on Icerya affected bushes. Places of liberation were periodically inspected and notes were taken as to the condition of the pest and the activities of the predator. In the course of his periodical examination of the various areas on the Nilgiris, Mr. Subbiah noticed the presence of beetles and grubs also in places where release of the beetles had not been made. For instance, in July, 1930 he found beetles and grubs at Golf Links, and Bishop's Down at Oottacamund on new infestations where the predators had not been liberated, and the only inference possible in these cases was that the beetles had migrated to these places by flight from the nearest liberated area, viz: Fairlawns from a distance of 7 miles nearly, helped perhaps by the monsoon winds. Similarly at Hookerodai, beetles had probably come in from the Avalanche area (7 miles off.) In the Coonoor area, it is presumed that Springfield had its contribution from Bandyshola about 2 miles off, while near Kotagiri a migration from a distance of about a mile or two was noticeable. In somewhat similar circumstances, Balachowsky (1929) noted that Rodolia beetles had found their way to Port-Cros (Iles d'Hyeres, France), although it was situated about 10 kilometers from the mainland and about 7 k.m. from the island of Porquerolles, where the beetles had been introduced some years back. He was of opinion that the migration of the beetles had been facilitated by the Mistral, which often blows with violence in these regions. These observations show that the beetles are capable of actively spreading from place to place in the infested areas and bringing the pest under efficient control.

Breeding and liberation of Rodolia beetles in the Upper Palnis Following a report of the appearance of Icerya on wattles on the Upper Palnis in 1941, a laboratory was opened at Kodaikanal on 1st July 1942 under the charge of Mr. M. S. Subbiah, and breeding was commenced with a stock of Rodolia beetles collected on the Nilgiris. In the course of four months, a sufficient stock was built up, to allow of a distribution of beetles in the affected areas being undertaken. Between October, 1942 and October 1943 an aggregate of 5,817 adults had been liberated all over the Upper Palnis and with further liberations the pest will be brought under control. Here also evidence was obtained as to the ability of the beetle to spread from place to place by migratory flight, as for instance in the case of individuals getting into the Kodaikanal area from Korappur where releases had been made.

Bionomics of Rodolia (Vedalia) cardinalis, Muls (Figs 2 to 6 Plate III.) As this predator has been introduced practically into almost all temperate and tropical regions of the world, its life-history is so well-known that there is no need of dilating on it specially. In view, however, of the importance of the study of its reactions to the environmental conditions met with in South India, observations were made by the staff in charge of the breeding stations on its behaviour under different seasonal conditions, and incidentally, various notes were recorded on the bionomics of the beetle in the course of the breeding work, and it is proposed to summarise some of the more important results of these studies. Most of these observations were made by Mr. M. S. Subbiah, while doing Rodolia breeding work first on the Nilgiris and at present on the Upper Palnis.

Mating When the weather is warm and bright, the beetles begin to pair soon after emergence, whereas in dull cold weather, they are inactive and lethargic and remain for days without pairing. *Egg-laying:* In warm weather pairing is followed quickly by egg-laying. Mature scales are generally selected for laying eggs, which are deposited singly and usually on the egg-sacs, though sometimes eggs may be laid on nymphs and even on bare twigs. The *egg* is elongate, torpedo-shaped, $\frac{3}{4}$ mm. long and scarlet red when freshly laid. The colour deepens before hatching takes place. The egg period varies from 6 to 12 days according to the fluctuations of temperature. A few hours after hatching, the young *grub*, which is about $\frac{7}{8}$ mm. long, crawls about in search of young scales, attacking and devouring them greedily. The older grubs feed on bigger nymphs, while the beetles themselves may attack both nymphs and mature scales, the egg-sacs being first attacked in the latter case. The grub moults thrice, before beginning to rest, and the active growing period may last 13 to 24 days, in accordance with the prevailing temperature. A well-developed grub measures about 6 mm. in length, and usually attaches itself to the twig by the anal end, and rests for 3 to 9 days before it moults and turns into a pupa. The *pupa* is naked and is usually 4 mm. long and $2\frac{3}{4}$ mm. broad, and turns into a beetle in the course of 5 to 15 days. As the new generation of beetles may lay eggs within 3 to 10 days of emergence, the duration of one generation — from egg stage to egg laying — may vary from 30 to 70 days, the length of duration varying inversely with the rise in temperature.

Egg-laying capacity Subbiah found that egg-laying commenced a few days after mating and continued throughout the life of the female provided there was frequent mating. Egg-laying was considerably reduced, when access to a male was prevented. The maximum number of eggs laid by a female was 897, and an average of 217 per female was worked out in 51 cases. The maximum number of eggs laid by a female during a day was 33. The pre-oviposition period varied from 3 to 17 days and the longest post-oviposition period was 32 days. The duration of active oviposition, as observed in 47 cases, varied from 3 to 99 days, and the average was about 49 days. (See Table IV appended.)

Longevity of adults The maximum longevity record for an adult male was 168 days, and for an adult female, 129 days. The duration of life is affected by various conditions. When adults were fed and allowed to mate, the average length of life of a male was 57 days and that of a female 59·7 days. When allowed to mate but not fed, it was 16·5 and 9 days respectively, and when neither mated nor fed, it was 21·3 and 19·75 days, the males apparently being capable of withstanding starvation better.

Number of generations in the year Under laboratory conditions both on the Nilgiris and on the Upper Palnis, eight successive generations of the beetle can be produced during a year. During the hot months of March—April—May, a complete generation — from egg-stage to egg-laying — may be passed in 33 to 35 days, while in the cold months it may take as long as 58 to 61 days. (*Vide* Tables II and III appended.) On the hills of South India, the season is comparatively dry and warm during the period — middle of March to middle of May; the South-west monsoon makes its influence felt from the middle of May to the middle of September, the days being cloudy, colder and more moist; from the middle of September to the first week of October, there is an interval of fairly warm dry weather; during October and November, the North-east monsoon prevails and is characterised by damp and chill weather; and cold weather conditions with comparatively low night temperatures obtain during December, January and February. As the life-history of the beetle in nature is profoundly influenced by these seasonal conditions, the daily maximum and minimum temperatures inside the laboratory were recorded, and from these data, monthly means were worked out for the period — July, 1929 to April, 1931 (Table I appended), with which correlations have been established between the length of the different generations and the corresponding temperature data. The duration of a generation is shortest in March, April and May, when the monthly means are between 68° and 70° F, and longest in December, and January, when they are about 63° F. (*Vide* Table II.)

The efficiency of the Rodolia Ladybird in the Control of Icerya *Icerya purchasi* is an insect with a high biotic potential. Not only does it have high reproductive capacity, being capable of laying 500 to 1000 eggs, but the vast majority of the progeny are females which are practically all capable of reproducing without sexual union. It has, however, only three generations in the year. On the other hand, the predator beetle, which has a fairly high rate of fecundity (being capable of laying 200 to 500 eggs), has a shorter life-cycle and can pass through 7 to 8 generations in a year, so that it is capable of rapidly outstripping the scale and bringing it under efficient control. Moreover, besides being a voracious feeder, it is specific in its food-habits in that it does not attack any other scale. Hence its well-deserved reputation as a highly efficient check on the Fluted Scale. But this circumstance acts adversely on the biotic potential of the predator.

for when the host insect becomes scarce or disappears as a result of its activities, want of food would naturally react on the beetle and cause it to suffer local extinction. When in the course of one or two seasons, stray specimens of the scale that had escaped the attentions of the predator, begin to multiply, the beetle would not be present in the initial stages to check its increase, so that there would be a recrudescence of the pest under these conditions. This is probably what had occurred on the Nilgiris, when a serious infestation of the scale was reported in 1942, after it had been under check for over a decade. Experience in Ceylon, South Africa, Rhedesia and in fact in all countries where the beetle has been introduced, however, shows that the beetle never dies down completely, but sooner or later asserts itself in spite of such a recrudescence of the scale and eventually keeps it within bounds. If, however, an early control is desired, the best plan would be to breed the beetle under cage conditions and liberate it in sufficient quantities to bring about early control. As this is what is being done both on the Nilgiris and the Palnis, it is hoped that the scale would before long be brought under control.

In this connection, it may be mentioned that responsibility for the work done up to the end of 1930 rests with the first author and that for work conducted since that time, with the second author.

Acknowledgements Before concluding, the authors wish to place on record their indebtedness to the following authorities for sending consignments of the ladybird for use in controlling the pest:— the Chief Entomologist, Union of South Africa, Pretoria for the prompt despatch of the earliest consignment, Mr. E. Ballard, then chief Plant Pathologist, Cairo, for ample Vedalia material received in excellent condition by air-mail, and last but not least, Dr. Guy A. K. Marshall, the enthusiastic Director of the Imperial Institute of Entomology, that great and eminently useful institution which is an asset to the British Empire, and to Dr. W. R. Thompson, the Superintendent of the famous Parasite Laboratory at Farnham-Royal, for the timely despatch of a most valuable consignment obtained from California. The writers wish to express their gratefulness to the successive Directors of the Madras Agricultural Department and to the Government of Madras (Development Department) for their uniformly kind support in regard to the measures proposed for the control of the scale. They are also thankful to the Director of Agriculture, Ceylon for help rendered at Colombo while taking charge of a Vedalia consignment from abroad and for furnishing local live Icerya material for feeding the beetles. Lastly, they wish to place on record their keen appreciation of the whole-hearted help and co-operation received from the various members of the Entomological Section whose services had been utilised in the course of this highly important work.

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TABLE I Monthly Temperature Data at the Keti Rodolia Breeding Laboratory Nilgiris: July 1929 to April 1931

Month	Daily Maximum			Daily Minimum			Month Mean
	Monthly Range		Monthly Average	Monthly Range		Monthly Average	
1929 July	70°	62°	67·0°	64°	59°	61·4°	64·2°
August	71°	64°	67·4°	64°	60°	61·6°	64·5°
September	73°	65°	68·7°	64°	60°	62·3°	65·5°
October	69°	63°	66·5°	64°	57°	61·4°	63·9°
November	73°	65°	68·8°	63°	53°	59·6°	64·2°
December	71°	62°	70·4°	62°	56°	58·4°	63·4°
1930 January	74°	62°	69·8°	62°	52°	57·6°	63·7°
February	75°	66°	71·5°	62°	52°	58·3°	64·9°
March	77°	69°	74·4°	64°	60°	62·1°	68·2°
April	80°	69°	75·1°	68°	62°	64·5°	69·8°
May	81°	65°	75·4°	68°	60°	65·0°	70·2°
June	79°	62°	71·8°	66°	59°	63·4°	67·6°
July	76°	62°	70·9°	64°	59°	61·0°	65·9°
August	75°	66°	70·0°	65°	59°	61·3°	65·7°
September	74°	68°	70·6°	64°	57°	61·6°	66·1°
October	73°	64°	68·6°	64°	58°	61·3°	64·9°
November	72°	64°	68·8°	63°	57°	60·3°	64·5°
December	73°	66°	69·6°	63°	51°	58·0°	63·8°
1931 January	74°	62°	69·3°	60°	55°	75·4°	63·4°
February	75°	72°	73·8°	62°	58°	59·4°	66·6°
March	76°	68°	72·9°	62°	58°	60·2°	66·5°
April	76°	70°	74·3°	64°	61°	62·8°	68·5°

TABLE II Duration of the different stages in successive generations of *Rodolia cardinalis* correlated with seasonal variations in temperature Keti breeding laboratory—July 1929 to April 1931

Serial number of Generation	Date of egglaying	Date of hatching and Egg period (in days)	Date of going to rest and Larval period (in days)	Date of pupation and Rest period (in days)	Date of emergence and Pupal period (in days)	Date of egg-laying and Pre-oviposition period (in days)	Total duration of generation (in days)	Monthly mean temperature in degree F.
I	20- 5-29	27- 5-29 7	11- 6-29 15	16- 6-29 5	24- 6-29 8	2- 7-29 8	43	Not observed
II	2- 7-29	12- 7-29 10	31- 7-29 19	9- 8-29 9	19- 8-29 10	24- 8-29 5	53	64·2° to 64·5°
III	24- 8-29	2- 9-29 9	21- 9-29 19	26- 9-29 5	8-10-29 15	15-10-29 7	55	65·5 Sep. 63·9 Oct.
IV	15-10-29	24-10-29 9	15-11-29 22	21-11-29 6	6-12-29 15	15-12-29 9	61	63·9 Oct. 64·2 Nov. 63·4 Dec.
V	15-12-29	26-12-29 11	19- 1-30 24	22- 1-30 3	1- 2-30 10	11- 2-30 10	58	63·7 Jan. 64·9 Feb.
VI	11- 2-30	21- 2-30 10	11- 3-30 18	15- 3-30 4	20- 3-30 5	23- 3-30 3	40	64·9 Feb. 68·2 Mar.
VII	23- 3-30	31- 3-30 8	14- 4-30 14	18- 4-30 4	23- 4-30 5	27- 4-30 4	35	68·2 Mar. 69·8 Apr.

VIII	27- 4-30	3- 5-30 6	19- 5-30 16	22- 5-30 3	27- 5-30 5	30- 5-30 3	33	69·8 Apr. 70·2 May
IX	30- 5-30	6- 7-30 7	26- 7-30 20	2- 7-30 6	15- 7-30 13	24- 7-30 9	55	67·6 June 65·9 July
X	24- 7-30	1- 8-30 8	19- 8-30 18	24- 8-30 5	4- 9-30 11	8- 9-30 4	46	65·7 Aug. 66·1 Sep.
XI	8- 9-30	15- 9-30 7	28- 9-30 13	2-10-30 4	13-10-30 11	20-10-30 7	42	66·1 Sep. 64·9 Oct.
XII	20-10-30	30-10-30 10	20-11-30 21	30-11-30 10	9-12-30 9	16-12-30 7	57	64·5 Nov. 63·8 Dec.
XIII	16-12-30	26-12-30 10	16- 1-31 21	23- 1-31 7	2- 2-31 10	11- 2-31 9	57	63·8 Dec. 63·4 Jan. 66·6 Feb.
XIV	11- 2-31	19- 2-31 8	12- 3-31 21	16- 3-31 4	23- 3-31 7	(not followed probably) 4	44	66·6 Feb. 65·5 Mar.

TABLE III Duration of the different stages in successive generations of *Rodolia cardinalis* observed at Kodaikanal breeding laboratory—July 1942 to October 1943

Serial Number of Generations	Date of Egg-laying	Date of hatching and Egg-period (in days)	Date of going to rest and Larval period (in days)	Date of pupation and Resting period (in days)	Date of emergence and Pupal period (in days)	Date of egg-laying and preoviposition period (in days)	Total duration of Generation (in days)
I	17- 7-42	27- 7-42 10	12- 8-42 16	16- 8-42 4	26- 8-42 10	2- 9-42 7	47
II	5- 9-42	14- 9-42 9	9-10-42 25	12-10-42 3	17-10-42 5	23-10-42 6	48
III	27-10-42	7-11-42 11	29-11-42 22	30-11-42 1	13- 7-42 13	21-12-42 8	55
IV	21-12-42	2- 1-43 12	29- 1-43 27	1- 2-43 5	8- 2-43 7	11- 2-43 3	54
V	11- 2-43	18-11-43 7	10- 3-43 20	11- 3-43 1	20- 3-43 9	26- 3-43 6	43
VI	26- 3-43	3- 4-43 8	23- 4-43 20	27- 4-43 4	6- 5-43 9	11- 5-43 5	46
VII	11- 5-43	20- 5-43 9	9- 6-43 20	11- 6-43 2	20- 6-43 9	29- 6-43 9	49
VIII	29- 6-43	8- 7-43 10	2- 8-43 25	5- 8-43 3	16- 8-43 11	26- 8-43 10	59
IX	27- 8-43	6- 9-43 10	5-10-43 29	5-10-43 3	20-10-43 12		54

TABLE IV Observations on fecundity and longevity of *Rodolia cardinalis* adults at Kodaikanal

Serial number of Pairs	Date of emergence	Age of female at first egglaying in days	Total No. of eggs laid	Daily average during period of fecundity	Maximum number of eggs laid per day	Longevity of adults		Duration of fecund period (days)
						Male (in days)	Female (in days)	
1	13-7-42	5	557	10	29	44	72	58
2	14-7-42	4	447	4·5	33	108	95	90
4	24-7-42	4	406	4·2	19	91	95	90
5	24-7-42	6	517	5·7	19	97	97	89
6	27-7-42	8	369	5·2	20	86	87	71
22	3-2-43	5	563	8·7	30	12	79	63
24	5-2-43	5	897	12·5	31	45	77	73
25	13-2-43	7	389	10·3	25	168	44	38
26	13-2-43	—	Nil	—	—	2	129	Nil
27	25-2-43	5	567	5·6	24	120	101	92
31	3-4-43	—	Nil	—	—	4	97	Nil
34	1-5-43	5	366	3·7	20	86	99	84
36	1-5-43	11	250	2·5	14	81	116	99
39	1-5-43	11	406	4·6	16	123	98	88
42	5-6-43	8	297	3·0	16	122	107	89
46	1-7-43	11	269	4·5	19	151	72	60
48	4-7-43	8	310	3·3	12	41	79	62

Babul Planting in Tank Beds

By E. K. VISWAM

Agricultural Demonstrator, Wandiwash

Timber for agricultural purposes and fuel are in short supply and are getting scarce, while the demand for them is on the increase, consequently the price ot timber and fuel is tending to soar high and in some cases beyond the capacity of the poorer people. Transport is at present restricted, no doubt, but that alone is not the only factor contributing to the scarcity. Wood is being used at a faster rate than the forests and the village sites can cope with. It is therefore necessary to think of methods of increasing the supply of wood immediately. The obvious remedy is planting trees. The trees selected should preferably be capable of growing without much of attention and cultivation, in lands that could not be cultivated economically. It is suggested that Babul (*Acacia arabica*) would answer the purpose and be ideal.

Babul is able to stand extreme droughty conditions and is classed as a xerophyte The tree has a deep root system and the leaf and leaflets are small and the amount of water transpired through the leaves is therefore limited and naturally the tree makes only slow growth. The tree is also able to stand water stagnation to a considerable extent as is evidenced by its growth in many tank beds in the southern districts, particularly Ramnad, and this is rather a curious trait. The babul wood is hard and makes excellent agricultural implements and first class fuel. The babul fruits, that is the pods, contain about 16 % of protein on a dry basis and are good