Table 6. Marginal Physical Product (MPP), Marginal Value Product (MVP) and Elasticity of Productin (EP) in the study area

Particulars	Head			Middle			Tail		
	NPK	Water	Labour	NPK	Water	Labour	NPK	Water	Labour
MPP	7.212	-12.062	-34.190	11.288	17.467	-33.278	7.172	9.263	-21.519
MVP	18.03	-30.16	-85.48	28.22	43.67	-83.20	17.93	23.15	-53.79
EP	0.463	-0.536	-1.659	0.651	0.675	-1.498	0.354	0.282	-1.049

input. In all the three regions, the degree of substitution possibilities was not high and it indicates that to a certain extent only these two inputs can be substituted beyond which they become complements. Since the variable, labour (X_3) was not significant in all the three regions, the substitution possibilities of X_3 with X_1 and X_2 were not calculated.

Conclusions

The study revealed that navarai paddy productivity and irrigation distance was negatively related and the average productivity in the study area was highest in the middle region, where as the water use efficiency was highest in tail region followed by middle region. The production function analyses showed that water and labour are being overused in the KRP ayacut area. There is a need to create awareness among the farmers on optimum use of scarce resources like water and education on water management practices are essential to achieve the goal of efficiency.

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THE EFFECT OF THREE PESTICIDES AND PESTICIDE INTERVAL ON *Cinnamomum verum* galls in Southern Sri Lanka.

T.K.H. SAHABANDU, ROHAN RAJAPAKSE, and DISNA RATNASEKERA

Department of Agricultural Biology,
Faculty of Agriculture,
University of Ruhuna,
Mapalana, Kamburupitiya,
Sri Lanka.

ABSTRACT

Experiments performed to find a suitable pesticide and a pesticide interval to control a gall causing insect *Trioza cinnamomi* indicated that there was significant effect of all three insecticides monocrotophos, lannate and methamidophos on tested distribution of galls at 3 crown levels tested. There were no significant differences between the crown levels in respect of gall distribution. Monocrotophos (30ml/25L) was found to be the most effective pesticide and 4 days interval was found to be the best spraying interval to control gall causing insect *T. cinnamomi*.

KEY WORDS : Pesticide, galls, cinnamon

Cinnamon (*Cinnamomum verum* Presl.) (*Fam. Lauraceae* is an indigenous plant in Sri Lanka. with an area of 6749 ha (Department of Statistics, 1992) and the production was 10016.4 MT. The quills, cinnamon bark oil and leaf oil are the commercial products of cinnamon plant. Sri Lanka is the highest exporter of cinnamon trade in the world and contributes 60% of the world export market. The main centres of cultivated cinnamon in Sri Lanka are Colombo (300 ha), Galle (9200 ha) and Matara (5900 ha) districts (Agric. Stat. of Sri Lanka, 1992).

The plant is attacked by insect pests at different degrees of development. Ayyar (1940) was the first to report on galls of cinnamon in leaves and shoot caused by *Pauropsylla depressa* Crawford.

The insect pests of cinnamon has been listed in Sri Lanka (Rajapakse and Kulasekara 1982) and he found the psyllid *Trioza cinnamomi* beselli (Homoptera : Triozidae) as the predominant insect pest. Gall insects generally do little damage to plants, because affected parts are able to carry out photosynthesis with near normal efficiency although the overall vigour of the plant may be reduced (Mathew, 1976). Feeding of the nymph of *T. cinnamomi* stimulates development of galls on the leaf surface. Galls are of about 3mm in diameter and a single developing nymph can be seen inside the gall. Mani (1973) reported the presence of *Eriophyes doctersi* Nalepa (Acarina : Eripyidae) causing galls of Cinnamon in India. Perera *et al.*, (1984) reported eriophyid mite *Eriophyes boisi* Gerber as the predominant gallmite found in cinnamon especially in mid country region of Sri Lanka. These mites form galls normally on the underneath surface of the leaf and several larvae and adults can be seen inside the gall. Dharmadasa (1993) classified leaf galls into 2 categories a jumping plant louse (*T. cinnamomi*) and a gall forming mite. He also reported that gall formation causes 16-20% leaf oil reduction. Perera *et al.*, (1984) found 18-43% reduction of leaf oil content and this may be due to the destruction of mesophyll and other leaf tissue which are the sites of photosynthesis.

However there were very little number of research reports dealing with insect galls and control of gall forming in Sri Lanka. The predominant species infesting galls in southern region is *T. cinnamomi* and the experiments reported here are dealt with this species. There were no pesticidal recommendations to our knowledge for the control of cinnamon gall forming insects in Sri Lanka. The objectives of these experiments were

(1) To select a suitable safe pesticide to control cinnamon gall forming insects.

(2) To determine a suitable pesticide interval.

The experiment was carried out at the Palolpitiya Cinnamon Research Station, Department of Export Agriculture in Matara district, southern region of Sri Lanka during July to, September 1994. The ambient temperature and relative humidity were 27°-30°C and 70-80° % respectively.

MATERIALS AND METHODS

Experiment 1 : Screening of pesticides to control cinnamon psyllids

The selected plants were free from galls and were at the growth stage of flushing or just after flushing. The experimental design was randomized complete block design. To avoid the experimental errors each plant was surrounded by eight plants. There were three replicates.

The following pesticides and dosages were used in the experiments listed below and the control treatment was water.

Trade Name	Common Name	dosage
1) Monocrotophos	Organo phosphorus	30ml/25L water
2) Lannate	Carbamate	30ml/20L water
3) Methamidophos	Organo phosphorus	30ml/20L water

Experiment 2 : Determination of the suitable pesticide interval

The treatment of spraying interval was investigated by applying insecticides to the same plants as in experiment one.

Table 1. Effect of pesticides on number of galls

Treatments	Mean number of galls
Monocrotophos	23.556[b]
Lannate	26.556[b]
Methamidophos	26.667[b]
Water	274.888[a]

Means with same letter are not significant at 5% level by MRT

Table 2. Effect of pesticide interval on mean number of galls

Treatments	Mean number of galls
Once in 4 days	84.333[b]
Once in 7 days	88.917[a]
Once in 14 days	90.500[a]

Means with same letter are not significant at 5% level by MRT.

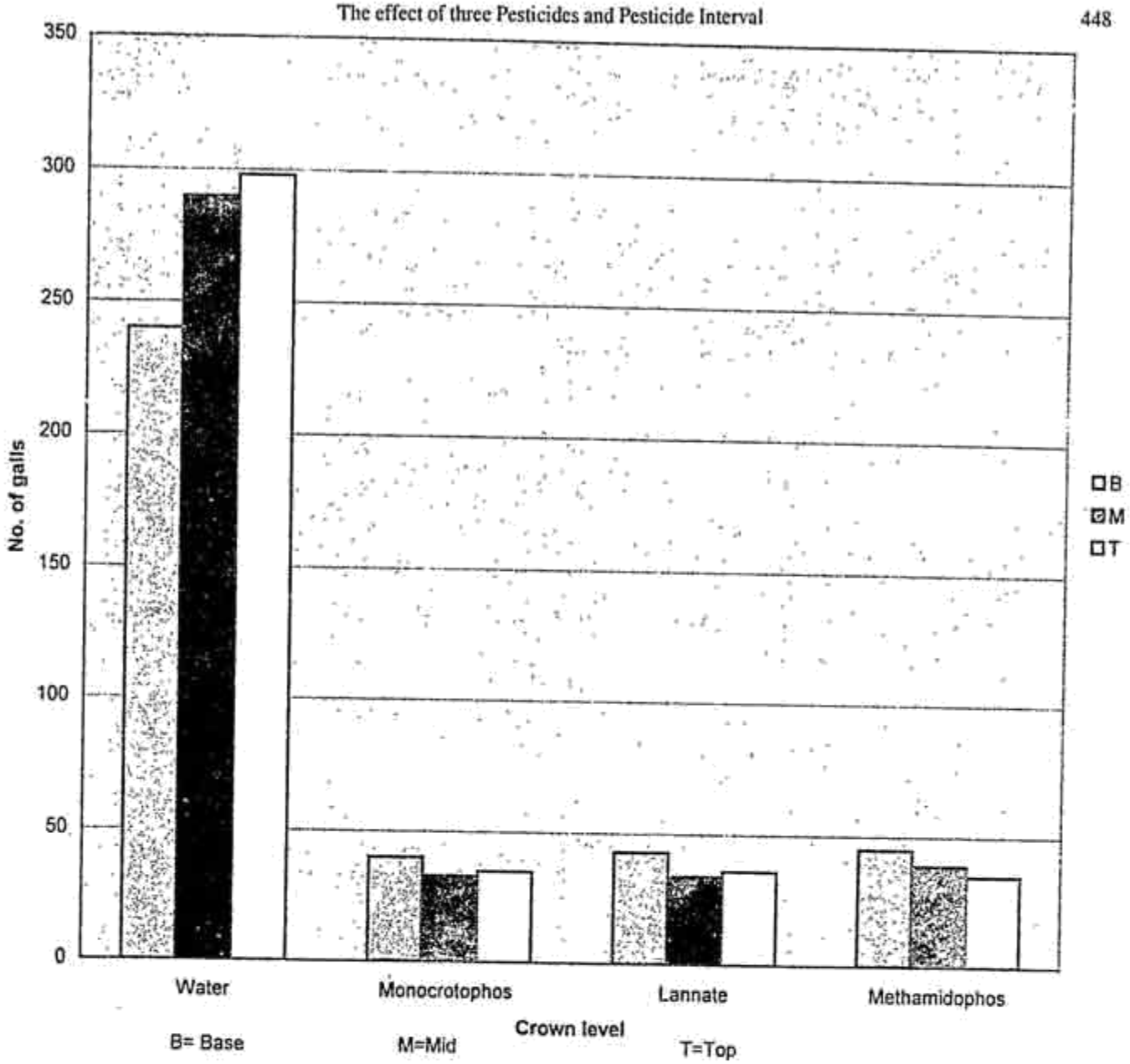

Fig. 1. Distribution of galls in three crown levels

The pesticide schedule is given below.

1.) Pesticide application - Once in 4 days

2.) Pesticide application - Once in 7 days

3.) Pesticide application - Once in 14 days

The data was recorded from July to September 1994 the number of galls were counted. Only the galls formed by *T. cinnamomi* was considered. In both experiments the crown levels of the cinnamon plants were grouped into three categories by using height of the plants as base, middle and top. The base level was considered as up to two feet from the groun level. The middle level was considered as up to three feet from the ground level. The remaining top portion of the plant was considered as the top level. The number of galls was counted according to the crown levels, and two surfaces of upper and lower of leaves.

RESULTS AND DISCUSSION

Experiment 1 : Screening of pesticides of control cinnamon psyllids.

There was significant effect of all three insecticides on distribution of galls at 3 crown levels tested when compared to control (fig. 1). There were no significant differences between the crown levels in respect of gall distribution in respect all 3 pesticides. Perera *et al.*, (1984) reported that number of new galls was found to increase rapidly when rainfall was apparently favorable for leaf flushing. This is due to fact that galls were found mostly in the younger leaves.

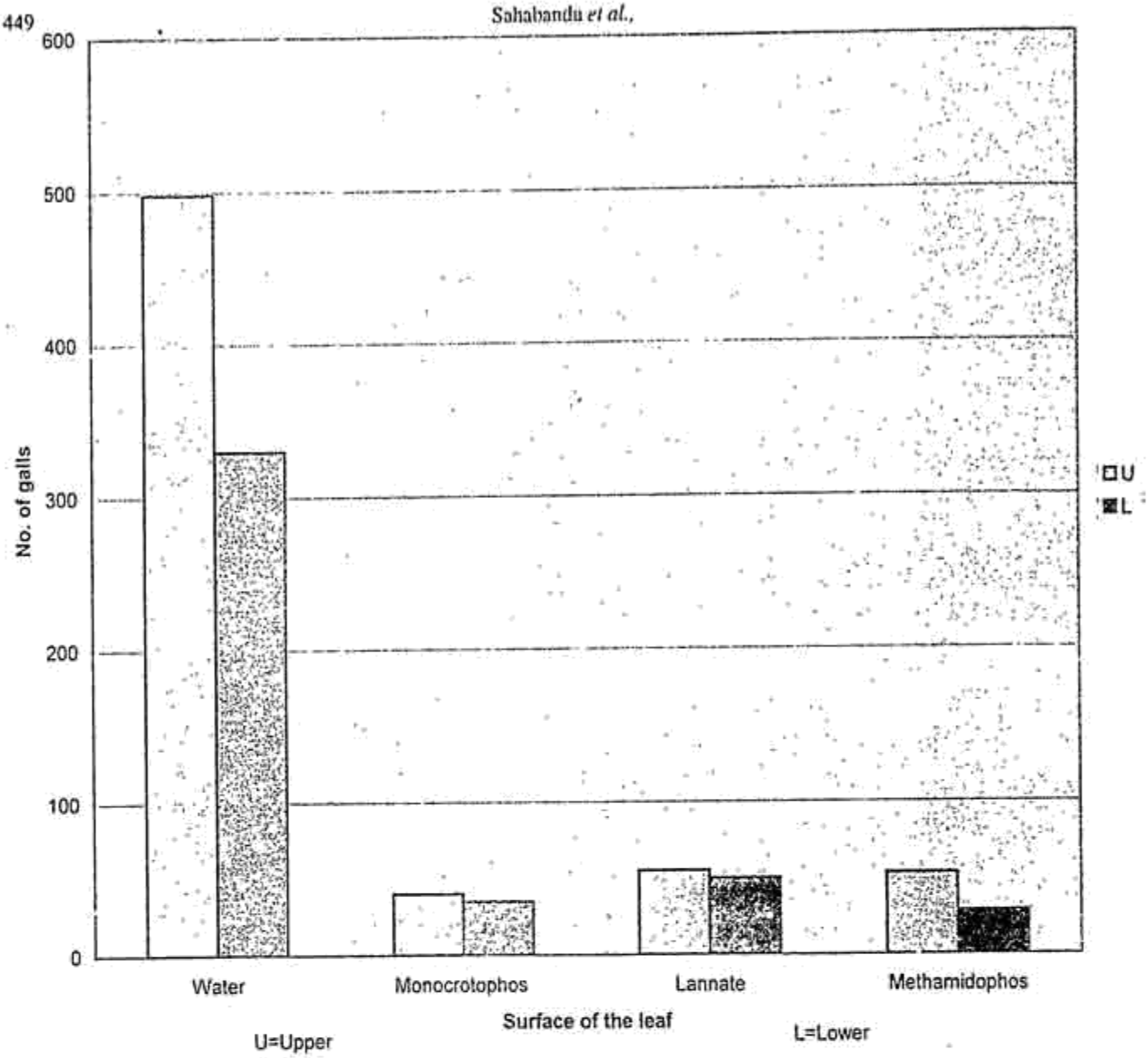

Fig. 2. Number of galls on upper and lower surfaces of the leaves

All the insecticides tested were recorded the significant effect on reduction of number of galls on upper and lower surfaces when compared to control (fig. 2). The number of galls produced by psyllid was greater on upper surface than the lower surface in all 3 pesticidal treatment. Perera *et al.*, (1984) reported that number of new galls found on young and medium age cinnamon leaves was greater than those in the old leaves and immature buds and succulent stems were also found to be affected.

Experiment 2 : Determination of the suitable pesticide interval

The application interval of once in four days was the most effective than the application of pesticide in 7 and 14 days (Table). Hence it is recommended that a shorter pesticidal interval will also observed that there is no significant effect of pesticide application intervals of 7 and 14 days.

Therefore the pesticide Monocrotophos is recommended for the control of *T. cinnamomi* in cinnamon among the three pesticides tested in this study.

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RESEARCH NOTES

VARIABILITY STUDIES IN F_3 AND F_4 GENERATIONS OF COWPEA

A well planned plant breeding programme for developing high yielding genotypes requires complete knowledge on the genetic and non-genetic variations available in the population. In the present study, the extent of genetic variability, heritability and genetic advance observed in the F_3 and F_4 generations of twelve cross combinations of cowpea genotypes are reported. Material for the present study comprised of twelve cross combinations of F_3 and F_4 populations. The material was planted during *Rabi*, 1995 (F_3 generation) and *kharif*, 1996 (F_4 generation) in randomized block design with three replication at a spacing of 45 x 15 cm. Each cross comprised of ten families. Each family planted in a row. At maturity, five plants were chosen at random from each family and observation were recorded on nine traits. Genotypic co-efficient of variation (GCV) and phenotypic co-efficient of variation (PCV) (Burton, 1952) heritability (Lush, 1940) and genetic advance (Johnson *et al.*, 1955) were worked-out.

The mean performance, range and genetic parameters are presented in Table 1. The PCV was higher than GCV but difference was low inferring the less environmental influence on many of the traits studied. The PCV and GCV for number of pods per plant and seed yield per plant were high in both F_3 and F_4 generation. Similar results were reported by many authors (Gowda *et al.*, 1991 ; Sawant, 1994 ; Selvi *et al.*, 1994 ; and Rewale *et al.*, 1995). Since heritability is an estimate of the heritable portion of the variation, a high heritability value in quantitative characters will be useful to provide a base for selection on the basis of phenotypic performance. High heritability coupled with high genetic advance as percent of mean was recorded for number of pods per plant, number of seeds per plant, crude fibre content and seed yield per plant in both F_3 and F_4 generations. This indicated that the expression of these characters is mainly under the influence of additive gene effect. Similar result of additive genetic effect for these traits was recorded by Sawant, (1994). High heritability coupled with moderate genetic advance as per cent of mean was recorded for plant height and pod length in both F_3 and F_4 generations. This indicated that the environment effect was low on these characters and these traits were mostly governed by additive gene action. Therefore, these traits offer a greater scope for further improvement by exercing selection. Number of branches per plant recorded low and moderate GCV, heritability and genetic advance as per cent of mean in F_3 and F_4 generations respectively. Phenotypic selection for this character could not be reliable because in addition to genetic components, this character shows considerable portion of environmental factor. This indicated that this trait is under the influence of non-additive gene action.

In general, the characters, plant height, number of pods per plant, pod length, number of seeds per pod and seed yield per plant provide good base for selection as they has high values of heritability and genetic advance. Emphasis should be laid on these traits for formulating reliable selection indices for developing high yielding cowpea genotypes.

KEY WORDS : Cow pea, variability, heritability, genetic advance