Table 2. Effect of micronutrient chelates on dry matter production, grain and straw yield of paddy IR.20 (Mean of three replications)

Treatments	Yield (kg/ha)		DMP (kg/ha)		
	Grain	Straw	Active tillering	Panicle initiation	Harvest
Control (NPK alone)	3230	6028	2651	4276	9258
Zn SO_4 @ 25 kg/ha	3890	7262	3392	5035	11152
0.5% Zn chelate F.S at Tillering stage	4053	7514	2854	6346	11567
0.5% Zn chelate F.S at Tillering and after 15 days	4403	8240	2908	5937	12643
0.5% Zn chelate F.S on paddy nursery + 1000 g Zn chelate as soil application + 0.5% Zn chelate F.S at tillering	4170	7931	3605	6105	12101
0.5% Zn chelate F.S on paddy nursery + 1000 g Zn chelate as soil application	4540	8383	3817	6287	12923
100 g CMM on paddy nursery + 1000 g CMM on soil application + 0.5% CMM F.S at tillering	4360	8176	3543	6303	12536
100 g paddy nursery + 1.0% CMM F.S. at tillering	3980	7523	3006	5842	11503
CD (0.05%)	623	750	466	512	869

FS - Foliar spray;
CMM - Chelated Micronutrient Mixture (ZnEDTA 60; FeEDTA 15; MnEDTA 3; CuEDTA 3; MgEDTA 11; CaEDTA 15; and B as boric acid 2 gram each)

positive relationship existed between the concentration of Zn and other nutrients also lends support to the above phenomenon (Table 2).

In general, foliar application of 0.5% Zn chelate significantly increased the pod, and haulm yield of groundnut, whereas in paddy, the same treatment in addition with 1000 g zinc chelate/ha as soil application increased the grain and straw yield.

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EFFECT OF NEEM PRODUCTS ON INSECT PESTS OF RICE AND THE PREDATORY SPIDER

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ABSTRACT

Neem oil (NO) 3% and neem seed kernel extract (NSKE) 5% high volume applications were superior to monocrotophos, neem cake extract (NCE) 10% and neem coated urea (NCU) treatments in suppressing brown planthopper (BPH) *Nilaparvata lugens* (Stal) population 3 days after spraying (DAS) in *Kharif* season. NO 3% and NSKE 5% also effectively checked leaf folder, *Cnaphalocrocis medinalis* (Gunee), upto 14 DAS and were on par with monocrotophos 0.04%. Ear head bug *Leptocorisa* spp population remained very low in all the plots treated with neem products. There was a better recolonisation of the predatory wolf spider, *Lycosa pseudoannulata* in neem treatments. The yield level in these treatments was comparable to that of insecticide treatment. Yellow stem borer, *Scirpophaga incetulas* (Walker) incidence was not reduced by neem products in the *rabi* season.

KEY WORDS : Neem Products, Rice Pests, Spiders

During the last two decades, the neem tree *Azadirachta indica* A. Juss, has come under close view of researchers around the world as the prime source of natural bioactive pesticides. About 400 in sect pest species belonging to different orders are adversely effected by neem derivatives (Jacobson, 1986; Schmutterer, 1995). In Indian subcontinent, neem cake application in rice fields against insect pests has been in use for several decades. Biological activity of neem seed derivatives against rice insect pests has also been demonstrated by several workers (Sexena *et al.*, 1981; Saxena and Khan 1985; Rajasekaran *et al.*, 1987; Raguraman and Saxena, 1994). However, detailed studies are lacking in tropical Indian situations. Hence, this field study.

MATERIALS AND METHODS

This experiment included ten treatments, replicated three times and conducted in two seasons (*kharif* and *rabi*)

Treatments:

T_1 NO 3 per cent 500 l/ha

T_2 NSKE 5 per cent 500 l/ha

T_3 NCE 10 per cent 500 l/ha

T_4 Basal application of NCU (Neem cake 100 kg + Urea 100 kg/ha) followed by NCE 5 per cent spray at 500 l/ha

T_5 NO 5 per cent followed by monocrotophos 0.04 per cent spray at 500 l/ha

T_6 NSKE 5 per cent followed by monocrotophos 0.04 per cent spray at 500 l/ha

T_7 NCE 10 per cent followed by monocrotophos 0.04 per cent spray at 500 l/ha

T_8 Basal application of NCU (Neem cake 100 kg + Urea 100 kg/ha) followed by NCE 10 per cent at 500 l/ha

T_9 Monocrotophos 0.04 per cent at 500 l/ha

T_{10} Control

The fertilizer application was done as per the recommended practice except for the treatments T_4 and T_8. Teepol 0.1 per cent was added to all spray treatments as surfactant. Observations on the pest population/damage as well as on the wolf spider, *Lycosa pseudoannulata* were made on 20 hills at random per plot at weekly intervals starting from 20 days after transplanting (DT). In both the experiments, the first round of spraying was given when any one of the insect pests reached economic

Table 1. Efficacy of neem products on the incidence of rice earhead bug and yield

Treatments	No. of bugs/20 hills					Grain yield kg/ha
	Days after first spraying					
	0	3	7	10	14	
NO 3% *	10.67^{a}	3.00^{bcd}	3.69^{b}	3.67^{b}	2.33^{ab}	6250^{a}
NSKE 5% *	8.33^{a}	3.00^{bcd}	1.67^{ab}	5.67^{b}	3.00^{b}	6125^{a}
NEC 10%@	8.33^{a}	1.33^{a}	3.00^{ab}	1.33^{a}	1.00^{a}	5250^{b}
NCU (NC 100 kg + Urea 100 kg/ha) ------NCE 5% *	10.67^{a}	1.67^{ab}	2.67^{ab}	1.00^{a}	1.00^{a}	5250^{b}
NO 3% *	3.33^{a}	2.33^{abc}	2.67^{ab}	4.00^{b}	2.00^{ab}	6125^{a}
NSKE 5% *	6.67^{a}	1.67^{ab}	2.00^{ab}	5.33^{b}	2.00^{ab}	6125^{a}
NCE 10% ----- Monocrotophos 0.04% @	6.67^{a}	3.67^{cd}	1.33^{ab}	1.67^{a}	1.33^{ab}	5375^{ab}
NCU (NC 100 kg + Urea 100 kg/ha) NCE 10%@	9.00^{a}	1.67^{ab}	2.33^{ab}	1.67^{a}	1.00^{a}	6125^{a}
Monocrotophos 0.04% *	8.67^{a}	4.67^{d}	1.00^{a}	4.33^{b}	2.33^{ab}	6000^{a}
Control	10.00^{a}	13.67^{c}	17.00^{c}	16.00^{c}	22.67^{c}	4125^{c}

NO : Neem oil, NSKE : Neem seed kernel extract; NCE : Neem cake extract; NCU ; Neem coated used

* One spray; @ Two sprays at weekly interval In a column, means followed by same alphabet are not significantly different (P=0.05) by DMRT

Table 2. Efficacy of Meem products and monocrotophos on the population of the spider, *L.pseudoannulata*

Treatments	No. of bugs/20 hills				
	Days after first spraying				
	0	3	7	10	14
NO 3% *	4.00^{a}	6.33^{bcd}	7.67^{b}	5.67^{bcd}	19.67^{ab}
NSKE 5% *	5.33^{a}	10.00^{ab}	10.00^{b}	4.33^{cd}	15.00^{bcd}
NEC 10%@	3.00^{a}	5.67^{bcd}	6.00^{b}	9.00^{abc}	18.00^{ab}
NCU (NC 100 kg + Urea 100 kg/ha) ------NCE 5% *	4.00^{a}	5.67^{bcd}	8.67^{b}	7.00^{abcd}	10.33^{cd}
NO 3% *	5.33^{a}	7.00^{bc}	11.00^{b}	6.33^{bcd}	15.33^{bc}
NSKE 5% *	5.67^{a}	7.33^{bc}	8.33^{b}	4.67^{bcd}	14.00^{ab}
NCE 10% ----- Monocrotophos 0.04% @	5.33^{a}	5.00^{bcd}	11.00^{b}	9.67^{ab}	15.00^{bcd}
NCU (NC 100 kg + Urea 100 kg/ha) NCE 10%@	3.33^{a}	3.67^{cd}	7.67^{b}	7.67^{bcd}	18.00^{ab}
Monocrotophos 0.04% *	3.33^{a}	3.67^{cd}	8.33^{b}	4.33^{d}	9.00^{d}
Control	9.00^{a}	15.00^{a}	19.67^{a}	15.33^{a}	24.67^{a}

NO : Neem oil, NSKE : Neem seed kernel extract; NCE : Neem cake extract; NCU : Neem coated used
* Single spray; @ Two sprays at weekly interval In a column, means followed by same alphabet are not significantly different (P=0.05) by DMRT

threshold level (ETL) in any one of the plots. The pest population/damage was recorded on 3,7,10 and 14 days after spraying. The details of the pests that reached ETL are as follows.

Kharif: The brown planthopper (BPH) *Nilaparvata lugens* (Stal.), leaf folder (LH), *Cnaphalocrocis medinalis* (Guenee) and earhead bug (EB), *Leptocorisa* spp. crossed ETL 58 DT The first round of spraying was given a day afte the pest had reached ETL. The second applicatio of treatments T_3, T_4, T_7 and T_8 was made 66 DT.

Rabi: In this experiment the yellow stembore (YSB), *Scirpophaga incertulas* (Walker) alon crossed ETL 45 DT. The first round of sprayin

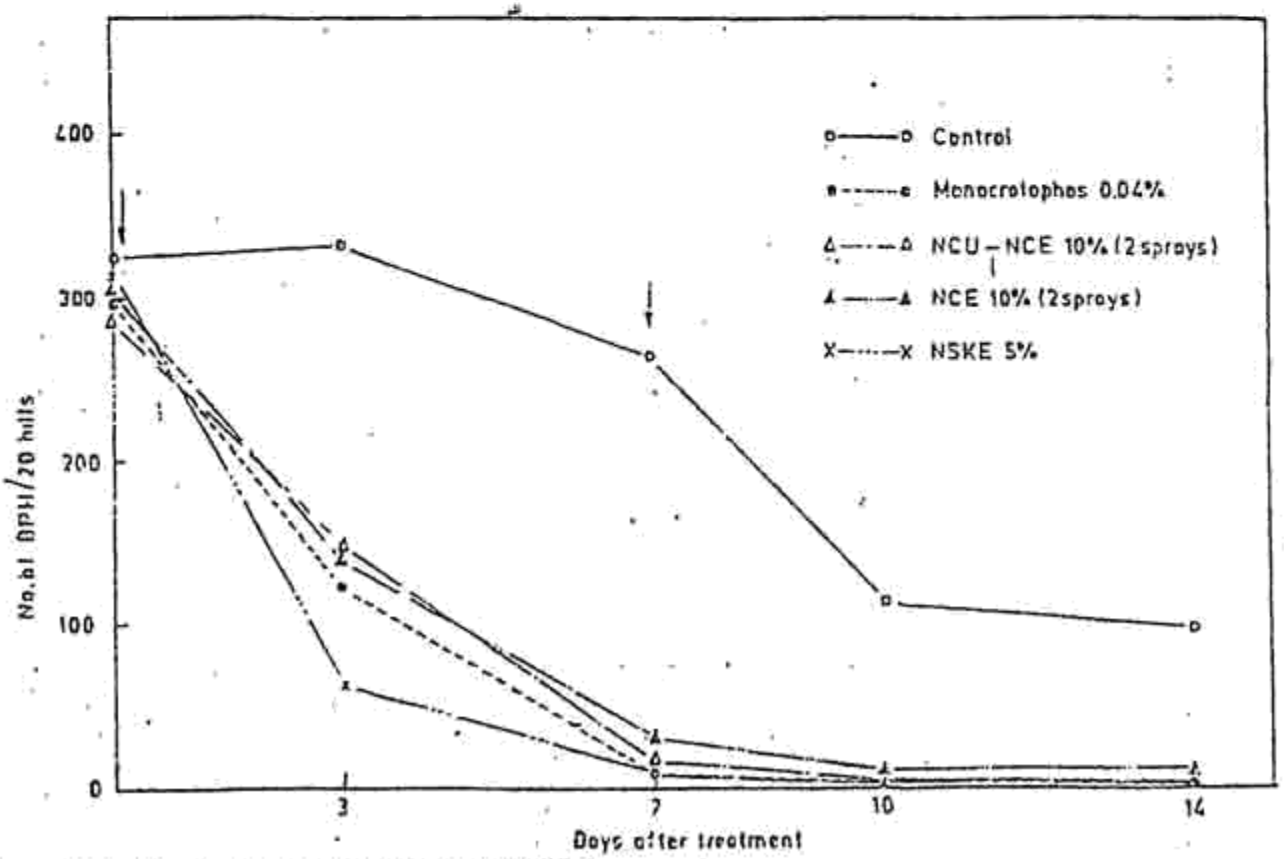

Fig.1 Field efficacy of neem products against rice BPH

Table 3. Efficacy of neem products against rice yellow stem borer and yield

Treatments	No. of bugs/20 hills (DAS)				
	Days after first spraying				
	0	7	14	21	28
NO 3% @	0.84^{a}	8.97^{ab}	11.77^{bc}	16.26^{cd}	6500^{ab}
NSKE 5% @	8.51^{a}	10.20^{ab}	14.01^{bcd}	17.94^{cd}	6250^{ab}
NEC 10%@	9.58^{a}	10.34^{ab}	14.38^{bcd}	16.77^{cd}	5750^{b}
NCU (NC 100 kg + Urea 100 kg/ha) ------NCE 5% @	7.80^{a}	10.09^{ab}	12.51^{bc}	15.11^{bcd}	6500^{ab}
NO 3% ----- Monocrotophos 0.04%@	9.54^{a}	11.10^{b}	13.76^{bcd}	11.50^{b}	6500^{ab}
NSKE 5% ----- Monocrotophos 0.04%@	9.93^{a}	11.56^{b}	15.78^{cd}	16.18^{cd}	5875^{b}
NCE 10% ----- Monocrotophos 0.04% @	8.84^{a}	11.06^{b}	14.80^{bcd}	17.94^{cd}	5875^{b}
NCU (NC 100 kg + Urea 100 kg/ha) NCE 10%@	7.82^{a}	9.03^{ab}	11.45^{b}	13.57^{bc}	6625^{ab}
Monocrotophos 0.04% *	8.30^{a}	7.92^{a}	8.30^{a}	8.94^{a}	7125^{a}
Control	8.78^{a}	12.53^{b}	17.12^{d}	19.65^{d}	5750^{b}

NO : Neem oil, NSKE : Neem seed kernel extract; NCE : Neem cake extract; NCU : Neem coated used

* One spray; @ Two sprays at 2 weeks interval In a column, means followed by same alphabet are not significantly different (P=0.05) by DMRT

was taken up 46 DT. The second round of spraying was given to all the treatments excepting T9 61 DT.

RESULTS AND DISCUSSION

Kharif : There was a significant reduction in BPH population in the NO 3 per cent and NSKE 5 per cent treated plots and their efficacy was superior to monocrotophos, NCE 10 per cent and NCU treatments 3 DAS (Fig. 1). Basal application of neem cake at 100 kg/ha with urea followed by spraying of NO at economic threshold levels was effective against BPH and LF. This is in

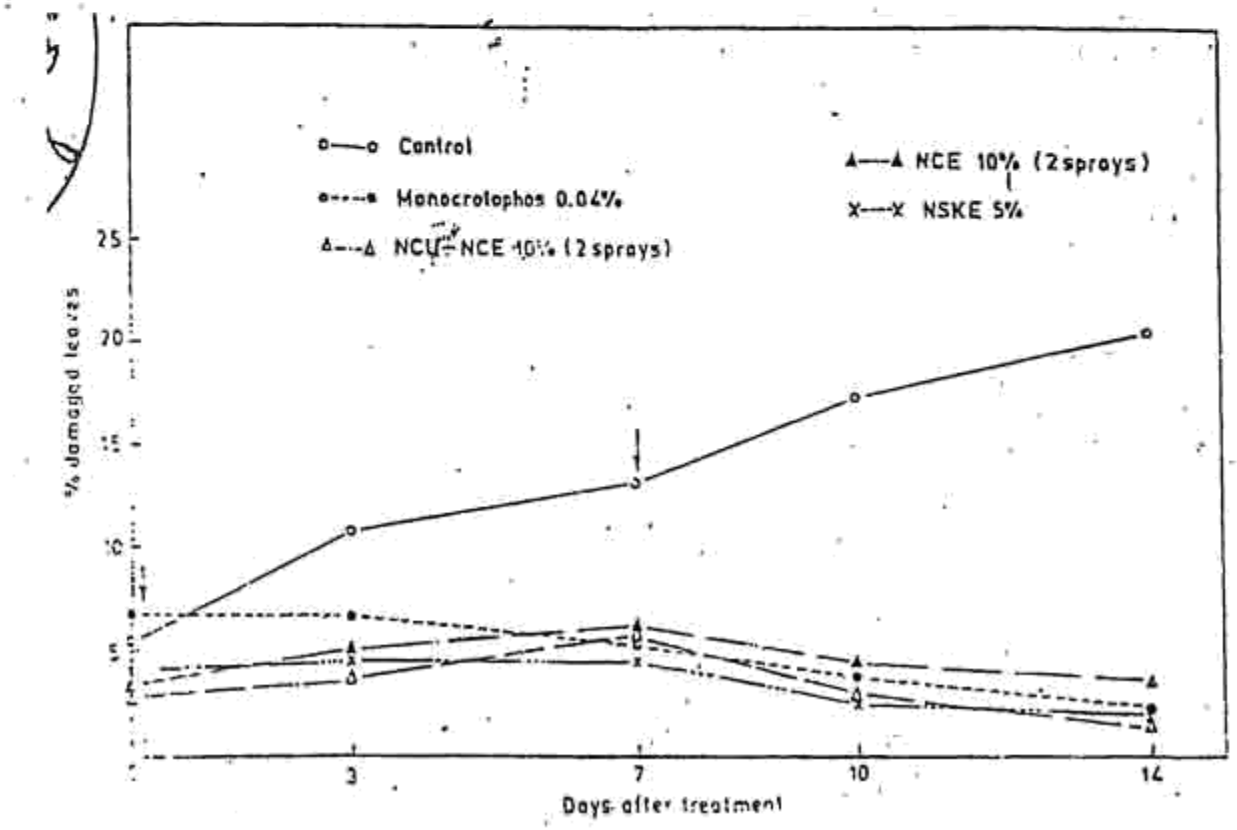

Fig.2 Field efficacy of neem products against rice leaf folder

accordance with the findings of Sellammal Murugesan *et al.*, (1987). Although the spider population was found to be reduced in all the neem treatments and monocrotophos, there was better recolonisation in the plots treated with neem products (Table 2). However, the reduction in population of spider could be attributed to the lower BPH population in neem treatments. Earlier report on the toxicity of NO + CAO revealed that even at the highest dose of 50 g/spider the oils did not adversely affect the spider (Saxena *et al.*, 1984).

NO was also found to be effective against LF and EB in the same experiment during *kharif* (Table 1 and Fig.2). NO could have acted as repellent, inhibitor of growth and development, feeding deterrent and also ovipositional deterrent against LF and EB. Earlier studies reported the aberrations in behaviour and morphogenetic effects in LF larvae. Saxena, *et al.*, (1987). reported that neem products were effective against EP mainly through feeding deterrency. Schmutterer (1995) emphasised that neem seed kernel extracts could be used effectively against rice insect pests.

Rabi : Neem products could not effectively control YSB (Table 3). This might probably due to low doses of neem compounds through systemic action or due to delayed application. Similar result was obtained by Krishnaiah and Kalode (1985) and Kalode and Krishnaiah (1987) who stated that neem oil was not effective against rice stem borer.

In the *kharif* season, the neem products *viz.* NO, NSKE, NCE and NCU reduced the incidence of BPH, LF and EB effectively. Where NO 3 per cent and NSKE 5 per cent needed only one application and neem cake treatments needed two applications. This might probably be due to slow action of the neem principles which are present in much lesser quantities in neem cake. However, the pest populations decreased to a minimum level in all the neem treatments and were comparable to the efficacy of insecticides. In the *rabi* season, all the neem treat ments were made twice since the effectiveness of the neem products was not comparable to monocrotophos in checking the stem borer.

Yield : High yield were obtained in *kharif* season when the incidence of pests was reduced due to the application of neem products. However, in the *rabi* season, the YSB incidence was not contained due to the application of neem products. Similarly, Abdul Kareem *et al.*, (1987) concluded that the net economic gain was consistently higher in plots treated with NO+ CAO mixture as compared to BPMC-treated plots, mainly because of reduced rice tungro virus incidence. Also, Saxena *et al.*, (1987) emphasized the only 80 g of Neem Seed Bitter (NSB) 10,000 ppm was needed at 8 l/ha to treat one hectare of rice crop using an ultra low volume applicator and even repeated application of NSB will have significant cost-benefit advantage over the most advanced commercial insecticides, such as synthetic pyrethroids. Further, they added that the yield in rice fields sprayed weekly with NSB was comparable to that in fields intensively protected with recommended insecticide.

The earlier reports and the results of the present study emphasised that the neem products are highly effective against BPH, LF EB in a cumulative way *via* physiological and behavioural distrubanees.

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FIELD STUDY ON CABLEGATION IRRIGATION SYSTEM

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ABSTRACT

A field study on Cablegation Irrigation System was carried out at the TamilNadu Agricultural University campus to examine the soil moisture storage and uniformity of moisture distribution. The system's performance was tested varying the pipe gradients to 1.0, 1.5, and 2.0 per cent and the outlet orientations to 60° and 90°. The system showed uniform depth of moisture storage along the lenght and depth of the Cablegation furrows whereas, the depth of storage decreased linearly from upstream to downstream end in the continuously irrigated furrow. The Uniformity Coefficient was found to be about 95 per cent, 20 per cent higher than that of the continuous. The overall performance of the system at both 60° and 90° orientations were good, only with slight variations in their moisture storage pattern at different pipe gradients.

KEY WORDS : Cablegation Irrigation System, Field study

Surface irrigation in our country has withstood the test of time because of its many advantages. However, their efficiency lies only around 55 per cent. Minor changes have been made to improve the efficiency of surface irrigation, but still the target of improving the efficiency above 55 per cent has not yet been reached. Realising this, an attempt was made to provide such an irrigation system that would not only lead to higher application and distribution efficiencies but also result in reduced labour requirements and low initial and maintenance costs. Cablegation is a new irrigation system that is being attempted in this direction. Cablegation refers to an automated mode of supplying water through a gated pipe system into the furrows. The pipe needs to be laid on a precise grade, causing water to flow through the outlets by moving a cable-attached plug slowly through the pipe (Kemper *et al.*, 1981).

An inherent characteristic of the system is that the flow to each furrow begins at a maximum rate and gradually decreases with time to zero. This gradual cut-back inflow rate has an effect on the furrow advance rates and infiltration distribution unlike other systems (Kincaid and Kemper, 1984).

METERIALS AND METHODS

The Semi-automated cablegation system developed was installed in the field to carryout the field study. The clay loam type soil had a basic infiltration of 1.32 cm/h with the field capacity and wilting point of 33.26 per cent and 14.06 per cent respectively. The bulk density was 1.24 g/cc.

The system designed consists of an inlet tank connected with 10 cm diameter PVC pipe (Fig.1). Outlets at 60 cm spacing were drilled to irrigate the furrows suitably. The water flow was controlled by