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Abstract - Experiment was carried out under field condition at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad to evaluate efficacy of different organic amendments superimposed with neem based pesticides against chilli sucking pests. Among different treatments, split application of neem cake @ 125 kg/ha + vermicompost @ 625 kg/ha at transplanting and 50 days later (with 50 per cent nitrogen) and Nimbecidine and NSKE spray interventions later was found to be the most effective treatment. The same treatment with 100% N resulted in significantly reduced activity of sucking pests and higher dry chilli yield (5.28 q/ha) with net return of Rs. 17492/-.

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I. INTRODUCTION

Chilli (*Capsicum annuum* L.) is a tropical and subtropical crop grown all over India. In India, it is grown on an area of 9.08 lakh ha with an annual production of 10.70 lakh tonnes. Karnataka produces about 1.44 lakh tonnes of chilli from an area of 1.74 lakh ha (Singhal, 2003). Although, the crop has got greater export potentialities besides huge domestic requirement, a number of limiting factors have been attributed for low productivity. Among them ravages caused by insect pests are significant ones. The pest spectrum of chilli crop is complex with more than 293 insects and mite species debilitating the crop in the field as well as in storage (Anon., 1987). Amongst these, aphids, *Myzus persicae* Sulzer., *Aphis gossypii* Glover., thrips, *Scirtothrips dorsalis* Hood., and yellow mite, *Polyphagotarsonemus latus* Banks are the most vital production constraints. A total of 39 and 57 insect pests were recorded in Karnataka in chillies on nursery and field crop, respectively (Reddy and Puttaswamy, 1983 and 1984).

During the last two decades insecticidal control of chilli pests specially in irrigated crop characterized by high pesticide usage has posed problems of residues in the fruits (Awasthi *et al.*, 2001 and Joia *et al.*, 2001). The reported presence of residues of many insecticides including ethion, chlorpyrifos, cypermethrin, endosulfan and quinalphos has seriously affected the export of chillies. It is learnt that chilli consignments are detained at the ports of importing countries very often due to high pesticide usage in India.

Therefore, several issues are need to be reexamined, put to evaluation so that a sound management programme is evolved with least or no pesticide usage. Since the pesticide consumption in rainfed Byadagi chilli in North-Western Karnataka is much less vis-à-vis irrigated chilli, coming up in large area in Krishna river basin in recent years, development of a non-chemical package or a programme with least pesticide usage is need of the hour for rainfed Byadagi chillies coming from the traditional area of North Western Karnataka.

II. MATERIAL AND METHODS

An experiment to evaluate different organic amendments against chilli pests was designed for two seasons under field condition in deep black cotton soil during kharif 2004 and 2005. The trials were laid out in randomized block design. Seedlings of chilli cv. Byadagi kaddi were procured from the Main Agricultural Research Station, UAS, Dharwad and transplanted during 4th and 2nd week of July 2004 and 2005 respectively, in plots of size 4.5x4.2m with 90x60cm spacing. Each plot had a density of 48 hills with 2 plants per hill. There were 20 treatments, laid out in RBD and replicated thrice. The crop was raised by following recommended package of practices plant protection measures (Anon. 2004) and optimum plant stand was maintained during both the seasons.

The organics were incorporated in the field thoroughly a week before as well as 50 days after transplanting (DAT) of chilli seedlings. The spray operations were carried out with a knapsack sprayer. To compare the efficacy of the treatments, 100 per cent recommended dose of fertilizer (RDF) with four sprays of recommended package of practices (RPP) at 2nd, 5th, 7th and 11th week after transplanting (WAT) as chemical check and a control with no manure and chemicals were maintained.

The population count of aphids, thrips and mite count was taken at 70 and 100 DAT. For counting these, five plants were selected randomly in each plot and tagged. Six leaves on the top canopy of each selected plant were observed by using destructive sampling procedure.

Green chillies were harvested from entire plot separately and yield per plot was recorded during each picking. Total yield was calculated by adding the yield of each picking. The per plot yield was converted to

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quintals per hectare. Dry chilli yield was obtained from the green chilli yield as per the procedure given by Anon. (2004), with the ratio of conversion of green chilli to dry chilli being 10:1.

Cost effectiveness of each treatment was assessed based on net returns. Net return of each treatment was worked out by deducting total cost of each treatment from gross returns. Total cost of production included both cultivation as well as plant protection charges.

Gross return = Yield x Market price

Net return = Gross return- Total cost

The data on mean population of sucking pests, was transformed to $\sqrt{x+1}$ and then subjected to one way ANOVA using M-STATC[®] software package. The treatment effect was compared by following Duncan's Multiple Range Test (DMRT).

III. RESULTS AND DISCUSSION

For the convenience of presenting results, treatment details listed in the following table are used with notations as given below.

Treatments	Details	Notations
T ₁	100% RDF, Neem cake 500kg/ha at transplanting (TP), Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	NC 500-SS (Spray schedule)
T ₂	100% RDF, Neem cake 250kg/ha at TP, 250kg/ha at 50 DAT, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	NC 250/250 - SS
T ₃	100% RDF, Vermicompost 2500 kg/ha, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	VC 2500 - SS
T ₄	100% RDF, Vermicompost 1250 kg/ha at TP, 1250kg/ha at 50 DAT, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	VC 1250/1250 - SS
T ₅	100% RDF, Neem cake 250 kg/ha + Vermicompost 1250 kg/ha at TP, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	NC 250 + VC 1250 - SS
T ₆	100% RDF, Neem cake 125kg/ha + Vermicompost 625kg/ha at TP and at 50 DAT, Nimbecidine (5ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	NC 125 + VC 625(2) - SS
T ₇	100% RDF, FYM 12.5 t/ha at TP, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	FYM - SS
T ₈	100% RDF crop residue 5t/ha at TP, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7 WAT, NSKE 5% at 11WAT	CR - SS
T ₉	50% N and 100% P&K, Neem cake 500kg/ha at transplanting, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	½N NC 500 - SS
T ₁₀	50% N and 100% P&K, Neem cake 250kg/ha at TP, 250kg/ha at 50 DAT, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	½ N NC 250/250 - SS
T ₁₁	50% N and 100% P&K, Vermicompost 2500 kg/ha, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	½ N VC 2500 - SS
T ₁₂	50% N and 100% P&K, Vermicompost 1250 kg/ha at TP, 1250kg/ha at 50 DAT, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	½ N VC 1250/1250 - SS
T ₁₃	50% N and 100% P&K, Neem cake 250kg/ha + Vermicompost 1250 kg/ha at TP, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	½ N NC 250 + VC 1250 - SS
T ₁₄	50% N and 100% P&K, Neem cake 125kg/ha + Vermicompost 625kg/ha at TP and at 50 DAT, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	½N NC 125 + VC 625(2) - SS
T ₁₅	50% N and 100% P&K, FYM 12.5 t/ha at TP, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	½N FYM - SS
T ₁₆	50% N and 100% P&K, crop residue 5t/ha at TP, Nimbecidine (5 ml/l) at 2 WAT, NSKE 5% at 5 WAT, Nimbecidine (5 ml/l) at 7WAT, NSKE 5% at 11WAT	½N CR - SS
T ₁₇	100% RDF, RPP-two sprays of Dimethoate (1.7ml/l) at 2, 5 WAT and dicofol (2.5ml/l) + carbaryl (4 ml/l) at 7, 11 WAT	RPP

T ₁₈	Untreated check (100% RDF)	Control
T ₁₉	100 % RDF- Control for sucking pests (two sprays of carbaryl (4 ml/l) at 7 and 11 WAT)	Control (SP)
T ₂₀	100% RDF-control for <i>H. armigera</i> (two sprays of Dimethoate (1.7ml/l) at 2 and 5 WAT and two sprays of dicofol (2.5ml/l) at 7 and 11 WAT)	Control (H)

IV. ACTIVITY OF KEY PESTS

The results on the effect of organic soil amendments on the activity of chilli pests, in general indicated the effectiveness of organics in suppressing the pest activity *vis- a-vis* comparison treatments. The details are presented here under.

a) Aphids

At 70 DAT, $\frac{1}{2}$ N NC 125 + VC 625(2) - SS (T₁₄), recorded significantly less number of aphids (0.12 and 0.16 aphid / leaf) during 2004 and 2005 respectively. The treatments, NC 500-SS, NC 250/250-SS, VC 2500-SS, VC1250/1250-SS, NC 250+VC 1250-SS, NC 125+VC 625 (2)-SS, $\frac{1}{2}$ N NC 500-SS, $\frac{1}{2}$ N NC 250/250-SS, $\frac{1}{2}$ N VC 2500-SS, $\frac{1}{2}$ N VC 1250/1250-SS, $\frac{1}{2}$ N NC 250+VC1250-SS, $\frac{1}{2}$ N NC 125+VC 625-SS, RPP and control(H) recorded aphid count, ranging from 0.12 to 0.81 during 2004 and from 0.16 to 0.89 in 2005, respectively. However, all the treatments recorded significantly less number of aphids compared to control. Further, the aphid population was slightly on the higher side during 2005, compared to previous year. Maximum number of aphids of 0.81 and 0.89/leaf was registered in control during 2004 and 2005 respectively. Similar pattern of treatment significance was noticed in pooled data also (Table 1).

At 100 DAT, aphid count in different treatments ranged from 0.11 to 0.72 and 0.14 to 0.81 during 2004 and 2005, respectively. The treatment, $\frac{1}{2}$ N NC 125 + VC 625(2) - SS recorded significantly less number of aphids 0.11 and 0.14 during 2004 and 2005, respectively followed by T10. Moderate pest activity was recorded in treatments like FYM - SS, CR- SS and control (SP). Pooled data also revealed same pattern of treatment significance.

b) Thrips

At 70 DAT, among the different treatments, effect of $\frac{1}{2}$ N NC 125 + VC 625 (2) - SS (0.13) was found to be significantly superior, but being on par with T₁, T₂, T₃, T₄, T₅, T₆, T₁₀, T₁₁, T₁₂, T₁₃, T₁₇ and T₂₀ except FYM - SS (0.70) CR - SS (0.63), $\frac{1}{2}$ N NC 500 - SS (0.28), $\frac{1}{2}$ N FYM - SS (0.62), $\frac{1}{2}$ N CR - SS (0.52) and control (SP) (0.57) which registered lower pest pressure. However all the treatments were found to be superior over control during 2004.

Similar trend was also noticed during 2005 with thrips count varying from 0.30 to 1.19. Pooled analysis of the data also indicated similar trend of treatment significance.

At 100 DAT, significantly least thrips count numerically (0.11) was noticed on the crop receiving NC 125 + VC 625(2) - SS (T₆), $\frac{1}{2}$ N NC 250/250 - SS (T₁₀), and $\frac{1}{2}$ N NC 125 + VC 625(2) -SS (T₁₄), but were on par with rest of the treatments except control and control (SP) during 2004.

During 2005, thrips population varied from 0.28 to 1.12. All the treatments except control and control (SP) were found to be equally effective against the thrips. Pooled data also revealed a similar pattern of treatment significance (Table 2).

c) Mites

At 70 DAT, significantly less number of mites (0.15) was recorded in $\frac{1}{2}$ N NC 125 + VC 625 (2)-SS(T₆), being on par with rest of the treatments except control and control (sp) during 2004 which registered significantly higher pest activity (1.23 to 1.07) (Table 3).

During 2005, all the treatments (T₁, T₂, T₃, T₄, T₅, T₆, T₉, T₁₀, T₁₁, T₁₂, T₁₃, T₁₄, T₁₇, T₂) except FYM - SS, CR - SS, $\frac{1}{2}$ N FYM - SS, $\frac{1}{2}$ N CR - SS, control and control (SP) were found to be equally effective against mite. Pooled data also revealed a similar trend.

At 100 DAT, pattern of treatment significance was similar as that of 70 DAT, with the same organics and botanical sprays excelling over others.

d) Dry chilli yield

During 2004, significantly higher dry chilli yield (5.62 q/ha) was registered in the treatment, NC 125 + VC 625 (2) -SS and was on par with NC 250/250 - SS (5.26 q/ha), $\frac{1}{2}$ N NC 250/250 - SS (5.03 q/ha) and $\frac{1}{2}$ N NC 125 + VC 625 - SS (5.59 q/ha). While others were next in the order. Significantly less dry chilli yield (1.57 q/ha) was recorded in control and was followed by control (SP) (2.11 q/ha) (Table 4).

During 2005, yields recorded in different treatments were relatively less as compared to previous year, but the same treatment NC 125 + VC 625(2)-SS was found to be most superior by recording highest yield of 4.93 q/ha and was on par with rest of the treatments except VC 2500 + SS, FYM - SS, CR- SS, $\frac{1}{2}$ N NC 500 - SS, $\frac{1}{2}$ N VC 2500 - SS, $\frac{1}{2}$ N VC 1250/1250-SS, $\frac{1}{2}$ N FYM -SS, $\frac{1}{2}$ N CR-SS, RPP, control, control (SP) and control (H) which yielded in the range of 1.17 to 4.26 q/ha. All treatments were found to be superior over control, in yields realised. Pooled data also revealed similar pattern of treatment significance and from the point of yield. the treatments were of the order T₆ < T₁₄ < T₂ < T₁₀ < T₁ < T₄ < T₅ < T₉ < T₁₂ < T₁₃ < T₁₇ < T₃ < T₁₁ < T₇ < T₈ < T₁₅ < T₁₆ < T₂₀ < T₁₉ < T₁₈.

Among the different treatments (Table 5), highest net returns (Rs 17,812/-) was recorded by $\frac{1}{2}$ N NC 125+ VC 625 (2)-SS, followed by NC 125+VC 625(2)-SS (Rs 17,492/-) and NC 250/250-SS (15, 942/-). Whereas, RPP recorded net returns of Rs 13647/-.

Lower activity of target sucking pests in the crop amended with vermin-compost and neem cake could be attributed to changed biochemistry of the plant due to organic nutrition, which could probably make plant system defensive against pest infestation, possibly by induced resistance.

Role of vermicompost and neem cake in managing the sucking pests in chilli has been on record. Varghese and Giraddi (2005) reported that neem cake @ 500 Kg/ha along with 50% RDF in combination with two and three sprays of RPP was superior by suppressing activity of thrips and mites and ultimately resulted in reduction in chemical interventions in crop ecosystem. Similar results were also obtained by Giraddi and Smitha (2004) against chilli mite and Mallikarjun Rao and Ahmed (1986) against chilli thrips.

The literature available pertaining to the combined efficacy of organic amendments and botanicals against sucking pests is scanty. However, Mallikarjun Rao *et al.* (1999b) reported that the soil application of neem cake @ 500 Kg/ha followed by seedling root dip with the per cent neem oil and neem oil emulsion spray later at weekly intervals significantly reduced the thrips population in chilli. Similar findings were also reported by the same author (1999a) against chilli aphids.

The present results on the utility of organics in pest management probably point induced resistance resulted due to variation in chemistry of the plant receiving organic amendments. This is supported by Surekha and Arjuna Rao (2001) who reported that induced resistance to pests and diseases is due to the higher polyphenol content in organic manure treated plants of okra.

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