Ecofriendly management of chilli leaf curl disease complex through plant products

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Abstract
A field trial was conducted during Rabi, 2015-16 cropping seasons. An attempt was made to find out the cost effective management schedule to minimize the crop loss. Seven plant products viz., Neem (Azadirachta indica L.) oil 0.03% 5ml/lit. Neem (Azadirachta indica L.) Seed Kernel Extract (NSKE) 5 % @ 5ml/lit. Karanj (Pongamia pinnata L.) oil @ 5ml/ lit. Nimbidicine 0.03% @ 3ml/lit., Achook 0.03% @ 3ml/lit., Neem gold 0.15 % @ 2ml/lit. and Nimactin 0.15% @ 2ml/lit. were evaluated against vector activity to reduce the leaf curl disease incidence. The minimum disease incidence was recorded to the extent of (23.45%) coupled with highest fruit yield of 64.45 q/ha in the treatment T2 having two sprays of NSKE 5 % @ 5ml/lit., at an interval of ten days during Rabi, 2015-16 cropping season. Maximum disease incidence (35.45%) in control with lowest yield (48.00/ha). Infection by chili leaf curl disease complex adversely affected yield attributing characters during Rabi season. Highest cost-benefit ratio of 1:17.13 was obtained by two sprays of NSKE 5% @ 5ml/lit. During Rabi crop season.

Keywords: Chilli, leaf curl, management, plant products

Introduction
Chilli (Capsicum annuum L.) is considered as one of the most important vegetable and commercial spice crops grown throughout warm temperate, tropical and subtropical regions of the World. Chilli also called red pepper belongs to the genus Capsicum under the Solanaceae family. Besides traditional use of chilli as vegetables, spices, condiments, sauces and pickles it is also being used in pharmaceuticals, cosmetics and beverages (Tiwary et al., 2005) [27]. In Jharkhand, it is grown mostly in the districts of Ranchi, Hazaribag, Palamu and Giridih etc. Although there is a scope to enhance the productivity of chilli, a number of limiting factors have been attributed to the productivity. The damage caused by insect pests and mite is of paramount importance. Chilli is known as suffer from as many as eighty three different diseases (Anonymous, 1966). Among these fungi, bacteria and viruses diseases which are the major limiting factors in successful crop production, aphids (Myzus persicae Sulzer), white fly (Bemisia tabaci Glover) and thrip (Scirtothrips dorsalis Hood) are the major insects which besides sucking the sap of the plant parts, also act as vectors of virus diseases like mosaic and leaf curl due to which the crop suffers heavy losses (Singh et al., 1998). Venkatesh et al. (1998) reported that chilli leaf curl complex was caused by chilli leaf curl Geminiivirus (CLCV) transmitted by Bemisia tabaci also by thrips (Scirtothrips dorsalis) and mites (Polyphagotarsonemus latus). Senanayake et al. (2006) [21] reported that a very high disease incidence (upto 100% plants during December, 2004) in farmers’ fields in Narwa and Tinwari villages at Jodhpur district Rajasthan was observed. Chilli leaf curl disease complex causes huge crop losses in Jharkhand state primarily due to attack of thrips, mites and white fly followed by invasion of chilli leaf curl virus. The objective of this study was to evaluate different plant products on vector activities to reduce chilli leaf curl disease complex.

Materials and Methods
To test the efficacy of seven plant products on incidence of chilli leaf curl disease complex, fruit yield and yield attributing characters, a field trial was conducted in glasshouse compound of Department of Plant Pathology, Birsa Agricultural University, Kanke, Ranchi, Jharkhand. The field trial was conducted in Randomized Block Design (RBD) during Rabi, 2015-16 crop season using the variety G-4. There were eight treatments with three replications. The plot size was 3 m x 1.5 m. Sterilized distilled water was sprayed with each spray in control plots. Required concentrations of all the seven plant products were sprayed two times in each plot. First foliar spaying was applied at 35 days after transplanting and second spraying was applied at 10 days after first spraying. Recommended doses of fertilizers N:P:K and FYM were applied @ 100:60:50/ha and 200 q/ha, respectively. Thirty five days old seedlings
trans planted. The details of treatments were as follows: T1 - Neem (Azadirachta indica L.) oil 0.03% @ 5ml/lit, T2 - NSKE 5% @5ml/lit, T3 - Karanj (Pongamia pinnata L.) oil @ 5ml/lit, T4 - Nimbidicine 0.03% @ 3ml/lit, T5 - Achook 0.03% @ 3ml/lit, T6 - Neem (Azadirachta indica L.) gold 0.15% @ 2ml/lit, T7 - Nimactin 0.15% @ 2ml/lit, T8 - Control. Disease incidence was observed in each plot by counting total number of plants as well as diseased plants.

Percent disease incidence was calculated by following formula suggested by Nene (1972):

\[
\text{% Disease Incidence} = \frac{\text{No. of Diseased units}}{\text{Total no. of assessed units}} \times 100
\]

Percent disease reduction was calculated by following formula:

\[
\text{Percent disease reduction} = \left(1 - \frac{C - T}{C}\right) \times 100
\]

Where,
C - Percent disease incidence in untreated plants,
T - Percent disease incidence in treated plants.

The per cent increase of yield in treatment over control was calculated from the following formula (Vanisree et al., 2013).

\[
\text{Per cent increase of yield in treatment over control} = \frac{\text{Yield in treatment} - \text{Yield in control}}{\text{Yield in control}} \times 100
\]

The fruit yield was recorded during the entire crop season and converted to per hectare. Yield was estimated after final picking of fruits. Cost - benefit ratio was calculated by using formula as follows:

\[
\text{Cost - benefit ratio} = \frac{\text{Net profit (Rs.)}}{\text{Cost of application}}
\]

Net Profit = Value of additional yield over control (Rs.) – Cost of application (Rs)

Following yield attributing characters were recorded as follows:
Plant height (cm), 2. No. of branches/plant (no.), 3. Fruit length (cm), 4. Fruit breadth (cm), 5. Fruit weight (gm). Yield attributing characters were recorded from randomly selected five plants in each replication of each treatment at maturity stage of crop.

### Results and Discussion

Chilli is grown during both Rabi and Kharif seasons in Jharkhand state. The crop is attacked by a number of diseases. Among these, chilli leaf curl disease complex is most prevalent. Seven plant products viz, Neem oil, Neem Seed Kernel Extract (NSKE), Achook, Neem gold, Nimactin, Nimbidicine, Karanj oil evaluated for their effects on vector activities, disease incidence and yield attributing characters during Rabi, 2015-16 cropping season. Neem products are well established commercially as botanical pesticides (Gurjar et al., 2012).

The data (Table-1) revealed that all the plant products reduced the disease incidence significantly in comparison to control. Two sprayings of NSKE 5% (T2) was recorded to the most effective botanical in reducing disease incidence (23.45%) coupled with highest yield (64.45 q/ha). The treatment T2 (NSKE 5%) was followed by Neem oil 0.03% (T1) having disease incidence of 24.63% and yield of 33.82 q/ha. Maximum disease incidence (35.45 percent) and lowest yield of 48.00q/ha was observed in control. The treatments T2 (NSKE 5%), T1 (Neem oil 0.03%) and T4 (Nimbicidine 0.03%) were significantly at par with each other. The maximum disease reduction over control was observed in T2 (33.86 %) followed by T1 (30.52 percent) and T4 (30.19 percent). The increase in yield over control was highest in T2 (34.28%) followed by T1 (33.82 %). Considering the per rupee returns, application of neem seed Kernel extract (NSKE) 5% @ 5 ml/lit. was highly economical which recorded cost-benefit ratio of 1:17:13 and net return/ha was recorded with highest yield (64.45 q/ha). Neem products are well established commercially as botanical pesticides (Gurjar et al., 2012).

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Similar results were reported by several earlier workers. Rashid and Khan (2000) [19], Harbant et al. (1999) [19], Singh and Sharma (1999) [19] demonstrated the use of botanicals, milk or cow urine in reducing the incidence of insect vectors, reducing viral disease of crops and improvement of yield. The influence of neem products in increasing the chilli yield was earlier reported by Smitha (2002) [25], Varghese (2003) [31] and Gundannavar (2007) [7]. They reported that neem based chemicals performed better and hence are best alternatives to RPP with on par/higher chilli yield. Similarly, Ukey and Saroda (2001) [28] reported that the application of NSKE alone also registered higher chilli yield. Similarly, neem derivatives viz., neem oil, Commnghoxcomnol Nekhex, Repelin and orgocide proved their superiority by recording least percent virus transmission and highest percent aphid mortality (Mariappan et al., 1993) [13]. Among the various indigenous material used for the control of thrips and mites NSKE (0.5%) + Nimbidicine (2ml /lit) found best treatments and gave higher chilli yield (10.64q/ha), thrips (0.4 LCI/plant) and mites (0.7 LCI/plant) control followed by NSKE (1%) (0.5 LCI/plant) and 0.8 LCI/plant for thrips and mites). The effectiveness of neem oil against chilli thrips was reported by Mallikarjuna Rao et al. (1999). They found that as seedling root dip one per cent neem oil emulsion was effective against chilli thrips, S. dorsalis. Amongst the various indigenous products experimented in the field, Neem gold ® (3%) and NO (3%) performed best and hence are best alternatives to chemicals when applied only once (Subba Rao et al., 2007).
Chakraborti (2000) reported higher number of fruits per plant with neem based insecticides. Similar results of reduced Leaf Curl Index (LCI) by the spray of botanicals, neem products and indigenous materials were also reported by Bagle (1988), Smitha (2002), Varghese (2003) and Mallapur et al. (2001) in chilli crop. The efficiency of many bio-pesticides in the management of leaf curl disease and controlling of insect pests was well documented by many workers in India on chilli crop fields (Venzon et al., 2008; Pandey et al., 2010; Elvin et al., 2014). The present investigation revealed that two sprays of neem seed kernel extract (NSKE) 5% @ 5ml/lit. was found to be best treatment for checking vector activity of chilli leaf curl disease complex resulting minimum leaf curl disease incidence (23.45 percent) coupled with highest fruit yield of 64.45 q/ha during Rabi 2015-16 crop season than other treatments. The next effective treatment was two sprays of neem oil, which recorded disease incidence of 24.63 percent and yield of 64.23 q/ha. NSKE was also recorded 33.86 percent disease reduction over control followed by neem oil which recorded 30.53 percent disease reduction. More or less similar findings were also reported earlier by other workers. NSKE was most effective against white fly. It also indicated that NSKE was having both virucidal as well as insecticidal properties (Singh et al., 1988; Raghupathi and Veeraragavatham, 2002) which may be due to presence of complex constituent that are insecticidal. Of these, Azadiractin is known to cause a range of effects on a number of species of insects. NSKE was known to contain a number of biologically active principles (alkaloids) and for this reason it has shown repellency, anti-feeding, anti-growth activities and direct toxicity against a number of insects (Schmutterer, 1990; Chakraborty and Chatterjee, 1999). Further, application of NSKE 5% @ 5ml/lit was highly economical which recorded cost-benefit ratio of 1:17.13 and net returned of Rs. 1,5543/- which recorded highest net return /ha among all the tested plant products. Maximum mean plant height, number of branches per plant, fruit length, fruit breadth, fruit weight were recorded by NSKE followed by spraying of Neem oil. These phenotypic characters were statistically significant. More or less similar finding was reported on the effects of biopesticides on yield attributing characters of chilli by Khailequazzawann et al. (2016). They observed that bio pesticides showed significant effect on yield and yield attributing characters of chilli. But plant height was not statistically significant within treatments. Ahmed et al. (2001) reported that neem oil application @ 5 ml/l recorded 34.28 percent reduction of chilli mite over control. It was apparent from the evaluation of botanicals in field condition that botanicals effectively reduce the disease against as compared to control. On the whole, it can be concluded that among the tested plant products, NSKE found most effective bio-pesticides against vector activities followed by neem oil and Nimbidicine whereas Karan oil was found to be least effective. All the tested plant products significantly checked the vector activities and effectively reduced the leaf curl disease incidence as compare to control. Therefore, the investigation strongly recommends the application of NSKE against vector activities to reduce chilli curl disease complex.

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References


