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Evaluation of various Botanicals against Predatory Spider Population in Rice, *Oryza sativa* L. in Kashmir

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ABSTRACT: As agrochemicals in agriculture are posing vast problems like environmental pollution, pesticide resistance, pest resurgence, toxicity hazards, secondary pest out breaks, residues in feeds, food, soil and water, and destruction of biodiversity of natural enemies. With a view these demerits, now-a-days further emphasis is being laid on IPM by means of botanicals. Botanicals have long been touted as an attractive choice to man-made chemical insecticides for pest management. Considering the importance of ecofriendly approaches to manage pests, the experiment was designed to determine relative efficacy of different botanical extracts against predatory spider population. So the study was conducted to determine the comparative bio-efficacy of five botanicals, each with three concentrations and untreated control (check) against predatory spider population on rice at MRCFC Khudwani Anantnag during *Kharif* 2019. The spider population was counted before application of botanicals and one, three, seven and fifteen days after botanical application. The mean live spider population per 10 hills ranged from 5.33-6.67 before treatment of botanicals and 3.33-6.00, 3.67-5.67, 3.67-6.00, 3.33-6.33 and 4.00-6.00 after treatment of botanicals, and that reduction in spider population was 11.66, 16.07 and 19.19%; 16.07, 18.05 and 22.13%; 13.09, 17.49 and 21.02%; 12.29, 15.03 and 16.66%; 17.20, 20.47 and 24.60%; at 1.0, 2.0, and 3.0 ml/ L of water in comparison to check (8.01%), respectively. The trend of reduction of spider's population decreased with time from one to fifteen days.

Keywords: Botanicals**,** spiders, rice, Neemazal, reduction, evaluation, yield.

INTRODUCTION

Rice, *Oryza sativa* (2n=24) (Poaceae; subfamily Oryzoides), is life describes the significance of rice in human diet. Rice (*Oryza sativa* L.) is an important cereal crop and source of calories for one-third of the world population. Rice being the staple food for more than 70 per cent of the population and the source of livelihood for 120 million rural households is the backbone of Indian agriculture. It has wide range of applications and is second only to wheat in terms of area and production. India and China account for 48% of total land area and 53.4 per cent of global rice production (FAO, 2019). Total production of rice during 2019-20 is estimated at record 117.94 million tonnes (DAC and FW 2019-20). West Bengal, Andhra Pradesh, Uttar Pradesh, Tamil Nadu, and Karnataka are the India's most important rice producing states. It is classified as a semi-aquatic annual grass crop. Low and uncertain income, degraded natural resource base, growing labour and energy shortages and threats of climate change are making Indian agriculture highly vulnerable and unsustainable (Pathak *et al*., 2018). The rice is bestowed with a lot of pests and natural enemies' complex. The insect pests of rice infest the crop from seedling to maturity in overlapping generations and vary in nature of damage along with plant tissue borers, foliage feeders, sap suckers, etc. About more than 100 species of insects have been recorded to infest the paddy crop but only about 20 of them are of major economic significance (Pathak and Khush 1979) and a few are widely distributed with great potential to create a havoc in the paddy crop. The common yield loss in rice had been accounted 30% via way of means of stem

borers, whilst plant hoppers cause 20%, gall midge 15%, leaf hoppers 10% and other pests 25% (Parasappa *et al*., 2017). Spiders are an abundant and important group of predators that inhabit many ecosystems and play a major role in the regulation of pest species (Riechert and Lockley 1984). These spiders are in general quite susceptible to pesticides, especially synthetic insecticides (Stark *et al*., 1994; Pekar, 2013).

Moreover it is the fact that occurrences of insect pest population in rice crop are varying at the same time due to climatic change and pests are becoming day by day a severe risk to rice crop in Kashmir. Pest management in agriculture is a not an easy task in the context of increasing agricultural productivity without upsetting the natural balance and deteriorating the environment. Agrochemicals in agriculture of course are helpful for defending crops against insect pests and diseases. However these chemicals are posing vast problems like environmental pollution, pesticide resistance, pest resurgence, toxicity hazards, secondary pest out breaks, residues in feeds, food, soil and water, destruction of biodiversity of natural enemies and a few social and political problems. According to National Research Council 1996 the impact of synthetic pesticides on beneficial arthropods and the human health risks posed by exposure to these chemicals are issues of growing concern. With a view these demerits, now-a-days further emphasis is being laid on IPM by means of botanicals. Botanicals have long been touted as an attractive choice to man-made chemical insecticides for pest management (Isman, 2006). Botanical pesticides are ecofriendly, economic, target specific and biodegradable. Their greatest strength is their specificity, as most of them are essentially non toxic and non pathogenic to animals and humans besides being ecofriendly (Reddy *et al.*, 2012).

Considering the importance of ecofriendly approaches to manage pests, the experiment was designed to determine relative efficacy of different botanical extracts against grasshopper and its natural enemies.

MATERIALS AND METHODS

The experiment was conducted at Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir (SKUAST-K), Mountain Research Centre For Field Crops (MRCFC) Khudwani Anantnag and division of Entomology, Wadura Campus Sopore in Randomized Block Design (RBD), having 16 treatments consisting of five botanicals each with three concentrations along with untreated check were replicated thrice and each sub plot measured 5m × 3m in size. Nursery of rice variety *Jhelum* was sown in the ist of May and transplanting was done during Ist week of June at 20 × 15 cm hill spacing. The treatments were Neemazal, cedar wood oil, lemon grass oil, eucalyptus oil, camphor oil, and untreated control each with three concentrations (Table 1). Botanicals were obtained from International Rice Research Institute, Rajendranagar Hyderabad.

Table 1: List of botanicals used against grasshopper, *Oxya nitidula* Walker infesting rice.

Sr. No.	Botanical name	Trade name	Formulation (ml / ha)	Dose (ml/ litre)
1.	Neemazal	Neemarin	1000	1.0
				2.0
				3.0
2.	Cedar wood oil	Cedar wood oil	1000	1.0
				2.0
				3.0
3.	Lemon grass oil	Citronella grass oil	1000	1.0
				2.0
				3.0
4.	Eucalyptus oil	Eucalyptus oil	1000	1.0
				2.0
				3.0
5.	Camphor oil	Camphor oil	1000	1.0
				2.0
				3.0
6.	Water spray (Untreated control)	Water spray (Untreated control)	1000	

Observations on spider population. Ten hills were selected at random in each subplot and the observations were recorded on the spider population. To study the effect of different botanicals on spider population infesting rice crop, pre-treatment observations were recorded one day before the botanicals application (1st DBT), while post-treatment observations were undertaken after 1st, 3rd, 7th and 15th days after treatment (DAT). Percent reduction was worked out by computing the difference between pre and post treatment observations by applying the Abbot's (1925) formula as mentioned as follows:

$$\% \text{ reduction} = \frac{\text{Pre treatment observation - Post treatment observation}}{\text{Pre treatment observation}} \times 100$$

Statistical analysis. The population of predator (spiders) was transformed by square root transformation. The per cent reduction in grasshopper, spiders and leaf damage was transformed into arc sine transformed values. The transformed data were then subjected to statistical analysis. The yield per plot was subjected to statistical analysis directly.

RESULTS

The data on mean number of live spider population and their percent reduction over pre treatment values at different treatments before 1st day and 1st, 3rd, 7th and 15th DAT at MRCFC, Khudwani Anantnag is presented in Table 2 and 3, respectively. Spider population ranged from 5.33-6.67 /10 hills at 1st DBT and 3.33-5.00, 4.33-5.67, 4.33-6.00, 4.67-6.33/10 hills at 1st, 3rd, 7th and 15th DAT, respectively. The results revealed that the mean live spider population per 10 hills ranged from 5.33-6.67 before treatment of botanicals and 3.33-6.00, 3.67-5.67, 3.67-6.00, 3.33-6.33 and 4.00-6.00 after treatment of botanicals, *viz*., neemazal, cedar wood oil, lemon grass oil, eucalyptus oil and camphor oil in comparison to control (5.00-6.00), respectively. All the botanicals were found at par in reducing the spider population on rice as compared to control throughout the period of experimentation (Table 3).

Table 2: Comparative bio-efficacy of botanicals against predatory spider population infesting rice variety *Jhelum* at MRCFC Khudwani.

Botanical	a.i in formulation	Rate of formulation (ml/ha)	Conc. (ml)	Pre treatment Count (1 DBT)	Mean live spider population per 10 hills				Pooled mean	Over all mean
					Post treatment count (DAT)					
					1	3	7	15		
Neemazal	1.0	1000	1	6.33 (2.70)	5.00 (2.44)	5.67 (2.58)	5.67 (2.58)	6.00 (2.64)	5.58 (2.56)	4.81 (2.40)
			2	5.67 (2.57)	4.00 (2.23)	4.67 (2.37)	5.00 (2.44)	5.00 (2.44)	4.67 (2.37)	
			3	5.33 (2.51)	3.33 (2.08)	4.00 (2.23)	4.67 (2.37)	4.67 (2.37)	4.17 (2.26)	
Cedar wood oil	1.0	1000	1	5.67 (2.57)	4.33 (2.30)	4.67 (2.37)	5.00 (2.44)	5.33 (2.49)	4.83 (2.40)	4.83 (2.40)
			2	6.33 (2.71)	4.33 (2.30)	5.00 (2.44)	5.33 (2.51)	5.67 (2.58)	5.08 (2.46)	
			3	6.00 (2.64)	3.67 (2.16)	4.33 (2.31)	5.00 (2.44)	5.33 (2.50)	4.58 (2.35)	
Lemon grass oil	1.0	1000	1	6.33 (2.70)	4.67 (2.38)	5.33 (2.51)	5.67 (2.58)	6.00 (2.64)	5.42 (2.53)	4.72 (2.38)
			2	5.33 (2.50)	4.00 (2.23)	4.33 (2.30)	4.33 (2.31)	4.67 (2.37)	4.33 (2.30)	
			3	5.67 (2.57)	5.67 (2.57)	4.33 (2.30)	4.67 (2.37)	5.00 (2.44)	4.42 (2.31)	
Eucalyptus oil	1.0	1000	1	6.67 (2.77)	5.00 (2.44)	5.33 (2.51)	6.00 (2.64)	6.33 (2.71)	5.66 (2.57)	3.77 (2.44)
			2	6.00 (2.64)	4.00 (2.23)	5.00 (2.44)	5.33 (2.50)	6.33 (2.71)	5.16 (2.47)	
			3	5.34 (2.51)	3.33 (2.08)	4.33 (2.31)	4.67 (2.37)	4.67 (2.37)	4.25 (2.28)	
Camphor oil	1.0	1000	1	6.00 (2.76)	5.00 (2.44)	5.33 (2.51)	5.67 (2.57)	6.00 (2.64)	5.50 (2.54)	4.94 (2.43)
			2	5.67 (2.58)	4.00 (2.23)	4.33 (2.31)	4.67 (2.37)	5.00 (2.44)	4.50 (2.33)	
			3	6.34 (2.71)	4.00 (2.23)	4.67 (2.38)	5.00 (2.44)	5.67 (2.58)	4.83 (2.41)	
Water			Check	6.00 (2.64)	5.00 (2.44)	5.33 (2.51)	5.67 (2.58)	6.00 (2.64)	5.50 (2.54)	5.50 (2.54)
C.D. (P=0.05)				**(NS)**	**(NS)**	**(NS)**	**(NS)**	**(NS)**	**(NS)**	

*Each figure is mean of three replications; Figures in parentheses are square root transformed values; DBT: Day before treatment; DAT: Day after treatment.

Table 3: Per cent reduction of natural enemies (spiders) infesting rice variety *Jhelum* with botanicals at MRCFC Khudwani.

Botanical	a.i in formulation	Rate of formulation (ml/ha)	Conc. (ml)	Pre treatment Count (1DBT)	Mean live spider population per 10 hills				Pooled mean	Over all mean
					Post treatment count (DAT)					
					1	3	7	15		
Neemazal	1.0	1000	1	6.33 (2.70)	20.95 (27.01)	11.42 (16.25)	9.52 (14.77)	4.76 (7.40)	11.66 (16.36)	16.07 (20.11)
			2	5.67 (2.57)	28.97 (32.51)	18.65 (25.42)	10.32 (15.43)	8.33 (9.99)	16.56 (20.84)	
			3	5.33 (2.51)	31.11 (33.67)	24.44 (29.45)	13.33 (17.70)	11.11 (11.75)	19.99 (23.14)	
Cedar wood oil	1.0	1000	1	5.67 (2.57)	23.41 (28.79)	18.65 (25.42)	13.89 (18.02)	8.33 (9.99)	16.07 (20.55)	18.75 (23.38)
			2	6.33 (2.71)	26.19 (30.54)	20.63 (26.82)	15.87 (23.46)	9.52 (10.76)	18.05 (22.90)	
			3	6.00 (2.64)	32.06 (34.23)	27.30 (31.36)	16.98 (24.28)	12.22 (16.88)	22.14 (26.69)	
Lemon grass oil	1.0	1000	1	6.33 (2.70)	20.63 (26.82)	15.08 (18.79)	11.11 (16.06)	5.55 (8.030	13.09 (17.42)	16.88 (21.44)
			2	5.33 (2.50)	20.63 (26.82)	17.85 (20.76)	16.19 (19.61)	11.43 (16.25)	16.52 (20.86)	
			3	5.67 (2.57)	28.97 (32.51)	23.41 (28.79)	18.65 (25.42)	13.09 (17.39)	21.02 (26.03)	
Eucalyptus oil	1.0	1000	1	6.67 (2.77)	19.84 (26.19)	14.28 (18.16)	10.32 (15.43)	4.76 (7.40)	12.30 (16.79)	14.66 (18.59)
			2	6.00 (2.64)	22.53 (27.99)	15.87 (19.14)	12.22 (16.88)	9.52 (10.76)	15.03 (18.69)	
			3	5.34 (2.51)	25.00 (29.77)	16.67 (19.78)	13.89 (15.59)	11.11 (16.06)	16.66 (20.30)	
Camphor oil	1.0	1000	1	6.00 (2.76)	24.52 (29.61)	19.76 (26.24)	15.59 (23.15)	8.93 (14.30)	17.20 (23.32)	20.41 (25.78)
			2	5.67 (2.58)	29.52 (32.69)	19.76 (26.24)	17.01 (20.05)	11.43 (16.25)	19.43 (25.70)	
			3	6.34 (2.71)	36.51 (37.12)	26.19 (30.54)	20.64 (26.82)	15.08 (18.79)	24.60 (28.32)	
Water			Check	6.00 (2.64)	16.98 (24.28)	10.32 (15.42)	4.76 (7.40)	0.00 (0.00)	8.01 (11.77)	8.01 (11.77)
C.D. (P=0.05)				**(NS)**	**(NS)**	**(NS)**	**(NS)**	**(NS)**	**(NS)**	

* Each figure is mean of three replications; Figures in parentheses are arc sine transformed values in DAT columns; DBT: Day before treatment; DAT: Day after treatment.

Impact of botanicals on the natural enemies revealed that these treatments were relatively safer to the spiders. The mean live spider population in neemazal treated plots was recorded as 6.33, 5.67 and 5.33 spiders per 10 hills in comparison to check (6.00) at 1st DBT while 5.00, 5.67, 5.67 and 6.00; 4.00, 4.67, 5.00 and 5.00; 3.33, 4.00, 4.67 and 4.67 spiders per 10 hills at 1.0, 2.0 and 3.0 ml/L of water in comparison to check (5.00, 5.33, 5.67 and 6.00) 1st, 3rd, 7th and 15th DAT, respectively. The mean live spider population in cedar wood oil treated plots was recorded as 5.67, 6.33 and 6.00 spiders per 10 hills in comparison to check (6.00) at 1st DBT while 4.33, 4.67, 5.00 and 5.33; 4.33, 5.00, 5.33 and 5.67; 3.67, 4.33, 5.00 and 5.33 spiders per 10 hills at 1.0, 2.0 and 3.0 ml/L of water in comparison to check (5.00, 5.33, 5.67 and 6.00) 1st, 3rd, 7th and 15th DAT, respectively. The mean live spider population in lemon grass oil treated plots was recorded as 6.33, 5.33 and 5.67 spiders per 10 hills in comparison to check (6.00) at 1st DBT while 4.67, 5.33, 5.67 and 6.00; 4.00, 4.33, 4.33 and 4.67; 3.67, 4.33, 4.67 and 5.00 spiders per 10 hills at 1.0, 2.0 and 3.0 ml/L of water in comparison to check (5.00, 5.33, 5.67 and 6.00) 1st, 3rd, 7th and 15th DAT, respectively. The mean live spider population in eucalyptus oil treated plots was recorded as 6.67, 6.00 and 5.34 spiders per 10 hills in comparison to check (6.00) at 1st DBT while 5.00, 5.33, 6.00 and 6.33; 4.00, 5.00, 5.33 and 6.33; 3.33, 4.33, 4.67 and 4.67 spiders per 10 hills at 1.0, 2.0 and 3.0 ml/L of water in comparison to check (5.00, 5.33, 5.67 and 6.00) 1st, 3rd, 7th and 15th DAT, respectively. The mean live spider population in camphor oil treated plots was recorded as 6.00, 5.67 and 6.34 spiders per 10 hills in comparison to check (6.00) at 1st DBT while 5.00, 5.33, 5.67 and 6.00; 4.00, 4.33, 4.67 and 5.00; 4.00, 4.67, 5.00 and 5.67 spiders per 10 hills at 1.0, 2.0 and 3.0 ml/L of water in comparison to check (5.00, 5.33, 5.67 and 6.00) 1st, 3rd, 7th and 15th DAT, respectively. When the data was pooled together, the mean live spider population in neemazal, cedar wood oil, lemon grass oil, eucalyptus oil and camphor oil was recorded as 5.58, 4.67 and 4.17; 4.83, 5.08 and 4.58; 5.42, 4.33 and 4.42; 5.66, 5.16 and 4.25; and 5.50, 4.50 and 4.83 spiders per 10 hills at 1.0, 2.0 and 3.0 ml/L of water in

comparison to check (5.50), respectively (Table 2). The overall pooled mean of the live spider population while pooling together all concentrations of the botanicals was 4.81, 4.83, 4.72, 5.02 and 4.94 spiders per 10 hills in neemazal, cedar wood oil, lemon grass oil, eucalyptus oil and camphor oil as compared to check (5.50), respectively (Table 2 and Fig. 1).

Amongst the botanicals, neemazal resulted 20.95, 11.42, 9.52 and 4.76%; 28.97, 18.65, 10.32 and 8.33%; 31.11, 24.44, 13.33 and 11.11% reduction of spider population at 1.0, 2.0 and 3.0 ml /L of water in comparison to check (16.98, 10.32, 4.76 and 0.00%) 1st, 3rd, 7th and 15th DAT, respectively. Cedar wood oil resulted 23.41, 18.65, 13.89 and 8.33%; 26.19, 20.63, 15.87 and 9.52%; 32.06, 27.30, 16.98 and 12.22% reduction of spider population at 1.0, 2.0 and 3.0 ml/L of water in comparison to check (16.98, 10.32, 4.76 and 0.00%) 1st, 3rd, 7th and 15th DAT, respectively. Lemon grass oil resulted 20.63, 15.08, 11.11 and 5.55%; 20.63, 17.85, 16.19 and 11.43%; 28.97, 23.41, 18.65 and 13.09% reduction of spider population at 1.0, 2.0 and 3.0 ml/L of water in comparison to check (16.98, 10.32, 4.76 and 0.00%) 1st, 3rd, 7th and 15th DAT, respectively. Similarly eucalyptus oil resulted 19.84, 14.28, 10.32 and 4.76%; 22.53, 15.87, 12.22 and 9.52%; 25.00, 16.67, 13.89 and 11.11% reduction of spider population at 1.0, 2.0 and 3.0 ml/L of water in comparison to check (16.98, 10.32, 4.76 and 0.00%) 1st, 3rd, 7th and 15th DAT, respectively. Camphor oil resulted 24.52, 19.76, 15.59 and 8.93%; 29.52, 19.76, 17.60 and 11.43%; 36.51, 26.19, 20.64 and 15.08% reduction of spider population at 1.0, 2.0 and 3.0 ml/L of water in comparison to check (16.98, 10.32, 4.76 and 0.00%) 1st, 3rd, 7th and 15th DAT, respectively (Table 2). When the data was pooled together, neemazal, cedar wood oil, lemon grass oil, eucalyptus oil and camphor oil resulted 11.66, 16.07 and 19.19%; 16.07, 18.05 and 22.13%; 13.09, 17.49 and 21.02%; 12.29, 15.03 and 16.66%; 17.20, 19.43 and 24.60% reduction in spider population at 1.0, 2.0 and 3.0 ml/L of water in comparison to check (8.01%), respectively. The overall effect of the botanicals evaluated against spiders while pooling together all concentrations was neemazal (16.07%), cedar wood oil (18.75%), lemon grass oil (17.20%), eucalyptus oil (14.66%) and camphor oil (20.41%) (Fig. 2).

Thus the effect of the botanicals evaluated against spiders was in the order of Camphor oil > Cedar wood oil > Lemon grass oil > Neemazal > Eucalyptus oil (Table 3).

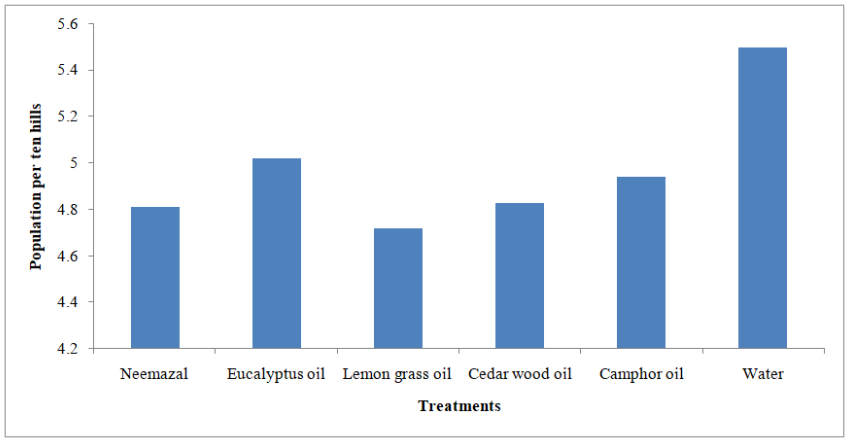

Fig. 1. Overall mean live spider population per ten hills of rice variety *Jhelum* in different botanical treatments.

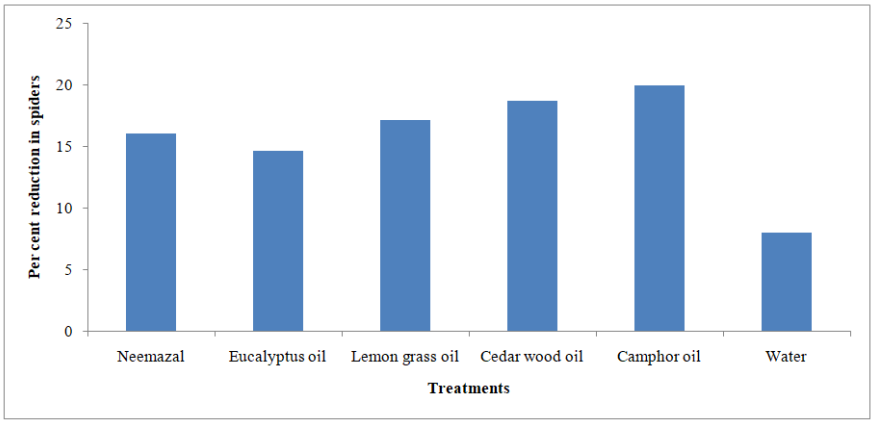

Fig. 2. Overall mean per cent reduction of spiders infesting rice variety *Jhelum* with different botanical treatments.

DISCUSSION

Spiders are an abundant and important group of predators that inhabit many ecosystems and play a major role in the regulation of pest species (Riechert and Lockley 1984). These spiders are in general quite susceptible to pesticides, especially synthetic insecticides (Stark *et al*., 1994; Pekar 2013). However; less work has been published on the effects of pesticides on spiders as compared to insects. Also certain natural insecticides, including those of plant origin, appear to be toxic to spiders. In the present studies, spiders were conspicuous predators observed in the experimental plot. The overall picture regarding the effect of botanicals on spider population in the experimental plot is presented in Table 2 and 3. The study envisaged that the mean live spider population in neemazal, cedar wood oil, lemon grass oil, eucalyptus oil and camphor oil, when the data was pooled together, was recorded as 5.58, 4.67 and 4.17; 4.83, 5.08 and 4.58; 5.42, 4.33 and 4.42; 5.66, 5.16 and 4.25; and 5.50, 4.50 and 4.83 spiders per 10 hills at 1.0, 2.0 and 3.0 ml /L of water in comparison to check (5.50), respectively. The neemazal, cedar wood oil, lemon grass oil, eucalyptus oil and camphor oil, when the data was pooled together, resulted 11.66, 16.07 and 19.19%; 16.07, 18.05 and 22.13%; 13.09, 17.49 and 21.02%; 12.29, 15.03 and 16.66%; 17.20, 19.43 and 24.60% reduction in spider population at 1.0, 2.0 and 3.0 ml/L of water in comparison to check (8.01%), respectively. Impact of these botanicals on spiders revealed that these treatments were relatively safer to the spiders infesting rice. The safety of botanicals to spiders was earlier reported by Saxena *et al*. (1984); Kareem *et al*. (1988); Nanda *et al*. (1993). These results are also in conformity with the findings of Dash *et al*. (2001) who reported that the botanicals are safer to natural enemies compared to synthetic insecticides. However, Lim *et al.* (1994) have reported effects of botanicals on the natural enemies ranging from harmless to adverse. Our results are in contrary to that of Muddasir *et al*. (2015) who have reported that neem and eucalyptus caused 36.68 and 33.38% reduction in spider population in a rice field in Pakistan, respectively. Joseph *et al.* (2010) evaluated the effect of *Azadirachtin* on two major tetragnathid spiders found in rice fields, *Tetragnatha mandibulata* and *T. maxillosa* and observed 24.50% reduction of population with *Azadirachtin*. Mansour *et al*. (1986) evaluated the effects of a 2.5% extract of neem seed prepared with several different solvents and Mansour and Nentwig (1988) evaluated the toxicity of neem, to juvenile and adult web-building and hunting spiders and fond less toxic to spiders, Punzo (1997) studied the effects of azadirachtin on spiders and showed negative effects on spider-lings body mass and the width of the prosoma as well as significant decrease in total haemocyte counts. Rezac *et al.* (2010) studied toxicity of Neemazal on the functional response of the spider and resulted in 10% mortality of spiders with Neemazal. Amalin *et al*. (2000) tested the toxicity of azadirachtin against anyphaenid spider, *Hibana velox* and found 20% mortality of spider.

CONCLUSION

The present field investigation was to build up an ecofriendly management of insect pests of rice under irrigated conditions with the help of botanicals, *viz*., neemazal, eucalyptus oil, camphor oil, lemongrass oil and cedar wood oil at different concentrations. The effect of botanicals on predatory population of spiders revealed that all the treatments were superior to the control for the reduction in spider population in rice. Hence, botanicals can be used in reduction of spider in rice without causing adverse effects on natural enemies and environment in Kashmir.

FUTURE SCOPE

The use of chemical pesticides cause significant reduction of pests but cause vast problems like environmental pollution, pesticide resistance, pest resurgence, toxicity hazards, secondary pest out breaks, and destruction of biodiversity of natural enemies. So emphasis should be laid on botanicals which are ecofriendly and can be used in rice field for pest management without affecting environment.

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Conflict of Interest. None.

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