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Influence of Bioagents Population under Different Weather Parameters in Rice Field Ecosystem of Eastern Uttar Pradesh Conditions

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ABSTRACT: An intensive study was undertaken to investigate the influence of bioagents population under different weather parameters in rice field ecosystem of Eastern Uttar Pradesh conditions for two consecutive years, 2014 and 2015. The population of bioagents were observed under particular weather parameters, *i.e.*, temperature maximum, temperature minimum, relative humidity, and rainfall in different growth stages of rice. The influence of weather parameters on population of bioagents were inferenced by correlation coefficient. Of the total observed population of most bioagent groups in all growth stages of rice under temperature maximum, temperature minimum, relative humidity, and rainfall, the correlation coefficients were - 0.602, - 0.581, - 0.490, and 0.768 for predators; - 0.459, - 0.436, - 0.337, and 0.649 for parasitoids respectively. The abundance of most bioagent groups, both predators and parasitoids were inferenced negative correlation with particular weather parameters, except rainfall was inferenced positive correlation. The correlation coefficients were inferenced non-significant between most bioagent groups and particular weather parameters in all growth stages of rice. The correlation coefficients between major bioagent species and particular weather parameters in all growth stages of rice were inferenced non-significant except between relative humidity and Field long jawed spider (*Tetragnatha maxillosa*) were inferenced significant correlation. The population of most of the major bioagent species were highly decreased with increasing temperature maximum, temperature minimum, and relative humidity and decreasing rainfall in seedling stage, and highly increased with moderately decreasing temperature maximum, temperature minimum, and relative humidity and increasing rainfall in transplanting stage, while moderately decreased with highly decreasing temperature maximum, temperature minimum, and relative humidity and increasing rainfall in flowering stage respectively.

Keywords: Bioagents population, Weather parameters, Rice field ecosystem, Influence, Eastern Uttar Pradesh, India.

INTRODUCTION

Rice is one of the most important staple foods of the world as well as India with integral part of their religious ceremonies, festivals and holidays. Rice is primarily a high calorie food. It contains about 6-7 % protein for milled rice with high biological value. The by-products of rice milling are used for variety of purposes, *i.e.*, cattle and poultry feed, insulation materials, cardboards and fuels. Rice straw is used as cattle feed and litter. It provides livelihood and food security to the about, 56% of the world population (7.46 billion) as well as 65% of the India population (1.32 billion). More than 60% of India population living in rural areas, where agriculture is the major concerns of rural economy, that is the backbone of Indian economy. The rice fragrance spreads to the entire world. More than 110 countries grow rice on one fifth of the world food grain crop area (Pathak and Khan, 1994; Maclean *et al*., 2002; Viraktamath, 2013; Heinrichs and Muniappan, 2017; Pathak *et al*., 2018; DAC&FW, 2018; FAOSTAT, 2019).

Bioagents are natural enemies, which attack various life stages of insects to kill as a prey or host to complete their life cycle. They are silent suppression factors of insect pests in rice ecosystem. Predators, parasitoids and pathogens are groups of bioagents. Predators and parasitoids are major groups of arthropod bioagents against rice insect pests. Predatory insects, Spiders & predatory mites are groups of predators, whereas parasitic wasp and flies are groups of parasitoids. Predators and parasitoids are varying in feeding and egg laying potential, which have been playing significant role in biological insect pest management (Pathak and Khan, 1994; Ooi and Shepard, 1994; David and Ananthakrishnan, 2004; Prakash *et al*., 2014; Rao, 2019).

Environment is the key factor of insect population dynamics. The warm humid environment is congenial for rice production and conductive to the survival and proliferation of arthropods biodiversity. The population of bioagents are mostly influenced by different weather factors, *i.e.*, temperature maximum, temperature minimum, relative humidity, and rainfall. Prasad *et al.* (2010), studied the incidence of white backed planthopper (WBPH), and its predators during rainy season (Kharif) in different paddy ecosystems of Uttara

Kannada district (Karnataka). The WBPH predating spider population was recorded maximum during November in Mundgod (3.60/ hill), followed by Sirsi (3.40) and Siddapura (2.86). The mirid population was highest during November in Sirsi (15.75 nymphs and adults/ hill), followed by Mundgod (14.20); Banavasi (10.40).

MATERIALS AND METHODS

The bioagent complex was observed under rice fields of Eastern Uttar Pradesh conditions for two consecutive years (2014 and 2015) to surveillance their incidence. The observation was surveyed in all10 districts of 03 administrative divisions of Eastern Uttar Pradesh, *i.e*., Gorakhpur (Gorakhpur, Deoria, Kushinagar and Maharajganj), Basti (Basti, Santkabirnagar and Siddharthnagar) and Azamgarh (Azamgarh, Mau and Ballia) under 03 growth stages of rice, *i.e.,* seedling, transplanting and flowering. The samples were taken randomly for concerned districts of all 03administrative divisions for each growth stage of rice for consecutively two years. There was each field selected at each division per growing stages for each year. There were 5 samples collected per field at the plot size of 100 m^2. Therefore, during the entire crop period a total of 90 samples (3 × 3 = 9 × 5 = 45 × 2 = 90) collected from 3 divisions for consecutive two years respectively. All 90 samples were converted average total of 18 samples (3 × 3 = 9 × 2 = 18) of all 03 divisions for two years. Samples were taken 03 times at interval of 20 days after sowing (20 DAS) for seedling stage, 30 days after transplanting (30 DAT) for transplanting stage and 60 DAT for flowering stage respectively. Each plot was selected 5 spots (4 in the corner at least 60 cm inside the border and one in the centre) to collect samples at 0.25m^2 /spot for seedling stage and at 01 hill/spot for transplanting and flowering stage to observe abundance of bioagents, and also at each plot, 05 net sweeps were made randomly at every 05 steps to observe abundance bioagents for all 03 growth stages of rice. The size of sweep net were 25 cm diameter and 70 cm handle and made up of nylon. The timing of sampling was 9.30 A.M. to 12.30 P.M. respectively. Each observation was recorded abundance of bioagents to calculate most bioagent groups and major bioagent species prevalent over major insect pests of rice. The observation was calculated correlation between most bioagent groups along with major bioagent species and meteorological factors at different rice growth stages.

The meteorological recording was coordinates with Gorakhpur meteorological station concerning tutiempo and time and date web portal regarding maximum and minimum temperature, relative humidity, and rainfall of months, *i.e.,* August, September, October, and December for years, 2014 and 2015 respectively. Taxonomic identification was verified with texts of reference, *i.e*., Dale, (1994); Barrion and Litsinger (1994); Pathak and Khan (1994); David and Ananthakrishnan (2004); Rice knowledge management portal (RKMP); and Subject experts respectively. The statistical inferences were verified with texts of reference, *i.e*., Chandel, (1999); Dhamu and Ramamoorthy, (2007); Rangaswamy, (2010).

RESULTS AND DISCUSSION

The population of bioagents were influenced by particular weather parameters, *i.e.* temperature maximum, temperature minimum, relative humidity, and rainfall. The population of most bioagent groups (predators and parasitoids) under different growth stages of rice were influenced by particular weather parameters accordingly. The influence of weather parameters on population of bioagents were inferenced by correlation coefficient. Of the total observed population of most bioagent groups in all growth stages of rice under temperature maximum, temperature minimum, relative humidity, and rainfall for sum of both the years 2014 and 2015, the correlation coefficients were - 0.602, - 0.581, - 0.490, and 0.768 for predators; - 0.459, - 0.436, - 0.337, and 0.649 for parasitoids; and - 0.581, - 0.560, - 0.468, and 0.752 for total population of most bioagent groups for rice insect pests complex respectively. The abundance of most bioagent groups, both predators and parasitoids were inferenced negative correlation with particular weather parameters, except rainfall was inferenced positive correlation. The all-correlation coefficients were inferenced non-significant between most bioagent groups and particular weather parameters in all growth stages of rice.

Of the total observed population of most bioagent groups for sum of both the years 2014 and 2015, were highly decreased with increasing temperature maximum, temperature minimum, and relative humidity and decreasing rainfall in seedling stage, and highly increased with moderately decreasing temperature maximum, temperature minimum, and relative humidity and increasing rainfall in transplanting stage, while moderately decreased with decreasing temperature maximum, temperature minimum, and relative humidity and increasing rainfall in flowering stage respectively. Similar findings have also been observed by Bhattacharyya *et al.,* (2006); Fahad *et al*., (2015); Chakraborty *et al*., (2016); Heinrichs and Muniappan, (2017); Krishnaiah and Varma (2018) (Table & Fig. 1).

The population of major bioagent species were also influenced by weather parameters. Of the total observed population of major bioagent species in all growth stages of rice under temperature maximum, temperature minimum, relative humidity, and rainfall for sum of both the years 2014 and 2015, the correlation coefficients were - 0.715, - 0.697,- 0.616, and 0.856 for Field wolf spider (*Lycosa pseudoannulata* Boesenberg & Strand); - 0.423, - 0.399, - 0.299, and 0.619 for Ground wolf spider (*Pardosa sumatrana* Thorell); - 0.539, - 0.517, - 0.422, and 0.717 for Common lynx spider (*Oxyopes javanus* Thorell); - 0.658, - 0.638, - 0.552, and 0.813 for Foliage jumping spider (*Phidippus indicus* Tikader); - 0.524, - 0.502, - 0.407, 0.705 for Tropical jumping spider (*Plexippus paykulli* Audouin); 0.981, 0.985, 0.998, and - 0.911 for Field long jawed spider (*Tetragnatha maxillosa* Thorell); - 0.673, - 0.654, - 0.569, and 0.824 for Brown long jawed spider (*Tetragnatha bengalensis*, Walckenaer); - 0.463, - 0.440, - 0.341, and 0.653 for Common green miridbug (*Cyrtorhinus lividipennis* Reuter); - 0.481, - 0.458, - 0.359, and 0.668 for Common ladybird beetle (*Coccinella septempunctata* Linnaeus); - 0.524, - 0.502, - 0.407, and 0.705 for Longhorned grasshopper (*Conocephalus longipennis* de Hann); - 0.423, - 0.399, - 0.299, and 0.619 for Euparasitic braconidwasp (*Cotesia flavipes* Cameron); 0.769, 0.753, 0.678, and - 0.895 for Common rice braconidwasp (*Bracon brevicornis* Wesmael); - 0.629, - 0.608, - 0.519, and 0.789 for Common rice scelionidwasp (*Telenomus rowani* Gahan); - 0.748, - 0.731, - 0.654, and 0.880 for Common rice eulophidwasp (*Tetrastichus schoenobii* Ferriere); - 0.524, - 0.502, - 0.407, and 0.705 for Common trichogrammidwasp (*Trichogramma japonicum* Ashmead) respectively. The abundance of most bioagent species was inferenced negative correlation with particular weather parameters, except rainfall was inferenced positive correlation. Among predators, the Field longjawed spider (*Tetragnatha maxillosa* Thorell) was inferenced highly positive correlation with particular weather parameters, except rainfall was inferenced highly negative correlation. Whereas among parasitoids, the Common rice braconidwasp (*Bracon brevicornis* Wesmael) was inferenced highly positive correlation with particular weather parameters, except rainfall was inferenced highly negative correlation. The correlation coefficients between major bioagent species and particular weather parameters in all growth stages of rice were inferenced non-significant except between relative humidity and Field longjawed spider (*Tetragnatha maxillosa*) were inferenced significant correlation.

Of the total observed population of major bioagent species for sum of both the years 2014 and 2015, the population of most of the major bioagent species were highly decreased with increasing temperature maximum, temperature minimum, and relative humidity and decreasing rainfall in seedling stage, and highly increased with moderately decreasing temperature maximum, temperature minimum, and relative humidity and increasing rainfall in transplanting stage, while moderately decreased with highly decreasing temperature maximum, temperature minimum, and relative humidity and increasing rainfall in flowering stage respectively. The population of Field longjawed spider (*Tetragnatha maxillosa* Thorell) and Common rice braconidwasp (*Bracon brevicornis* Wesmael) were highly increased with increasing temperature maximum, temperature minimum, relative humidity and decreasing rainfall in seedling stage. While, the population of Field longjawed spider was moderately and highly decreased; and the population of Common rice braconidwasp was highly and moderately decreased in transplanting stage and flowering stage of rice respectively. These results are in agreement with these of Bhattacharyya *et al.*, (2006); Fahad *et al.*, (2015); Chakraborty *et al*., (2016); Heinrichs and Muniappan, (2017); Krishnaiah and Varma, (2018) who found similar trends (Table & Fig. 2).

CONCLUSION

Both most bioagent groups (predators and parasitoids) and major bioagent species were highly decreased with increasing temperature maximum, temperature minimum, and relative humidity and decreasing rainfall in seedling stage, and highly increased with moderately decreasing temperature maximum, temperature minimum, and relative humidity and increasing rainfall in transplanting stage, while moderately decreased with decreasing temperature maximum, temperature minimum, and relative humidity and increasing rainfall in flowering stage respectively.

Table 1: Bioagents Population under Weather Parameters (Sum of 2014 & 2015).

Influence of Bioagents Population under Weather Parameters								
Most Bioagent Groups	**Growth Stages of Rice**			**Weather Parameters**				
	Seedling	**Transplanting**	**Flowering**	**Correlation Coefficient**				
	34.10	32.40	30.10	**Observations**	**Temperature Maximum (°C)**			
	25.20	21.60	16.25			**Temperature Minimum (°C)**		
	78.70	75.85	69.40				**Relative Humidity (%)**	
	1000.60	1007.70	1011.95					**Rainfall (mm)**
Predators	380	705	602	**Population**	- 0.602	- 0.581	- 0.490	0.768
Parasitoids	50	108	81		- 0.459	- 0.436	- 0.337	0.649
Total	**430**	**813**	**683**		**- 0.581**	**- 0.560**	**- 0.468**	**0.752**

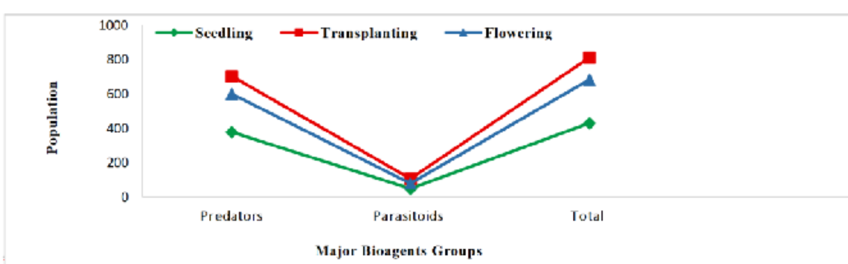

Fig. 1. Bioagents Population under Weather Parameters (Sum of 2014 & 15).

Table 2: Major Bioagents Population under Weather Parameters (Sum of 2014 & 2015).

Influence of Major Bioagents Population under Weather Parameters									
Sr. No.	**Major Bioagent Species**	**Growth Stages of Rice**			**Weather Parameters**				
		Seedling	**Transplanting**	**Flowering**	**Correlation Coefficient**				
		34.10	32.40	30.10	**Observations**	**Temperature Maximum (°C)**			
		25.20	21.60	16.25			**Temperature Minimum (°C)**		
		78.70	75.85	69.40				**Relative Humidity (%)**	
		1000.60	1007.70	1011.95					**Rainfall (mm)**
1.	**Field wolf spider**	16	39	35	**Population**	- 0.715	- 0.697	- 0.616	0.856
2.	**Ground wolf spider**	25	31	28		- 0.423	- 0.399	- 0.299	0.619
3.	**Common lynx spider**	12	25	20		- 0.539	- 0.517	- 0.422	0.717
4.	**Foliage jumping spider**	20	36	32		- 0.658	- 0.638	- 0.552	0.813
5.	**Tropical jumping spider**	19	29	25		- 0.524	- 0.502	- 0.407	0.705
6.	**Field longjawed spider**	24	23	20		0.981	0.985	0.998*	- 0.911
7.	**Brown longjawed spider**	14	27	24		- 0.673	- 0.654	- 0.569	0.824
8.	**Common green miridbug**	20	33	27		- 0.463	- 0.440	- 0.341	0.653
9.	**Common ladybird beetle**	21	30	26		- 0.481	- 0.458	- 0.359	0.668
10.	**Longhorned grasshopper**	9	19	15		- 0.524	- 0.502	- 0.407	0.705
11.	**Euparasitic braconidwasp**	0	6	3		- 0.423	- 0.399	- 0.299	0.619
12.	**Common rice braconidwasp**	18	7	8		0.769	0.753	0.678	- 0.895
13.	**Common rice scelionidwasp**	0	7	5		- 0.629	- 0.608	- 0.519	0.789
14.	**Common rice eulophidwasp**	0	8	7		- 0.748	- 0.731	- 0.654	0.880
15.	**Common trichogrammidwasp**	0	10	6		- 0.524	- 0.502	- 0.407	0.705

***** Significant at 5% level of significance.

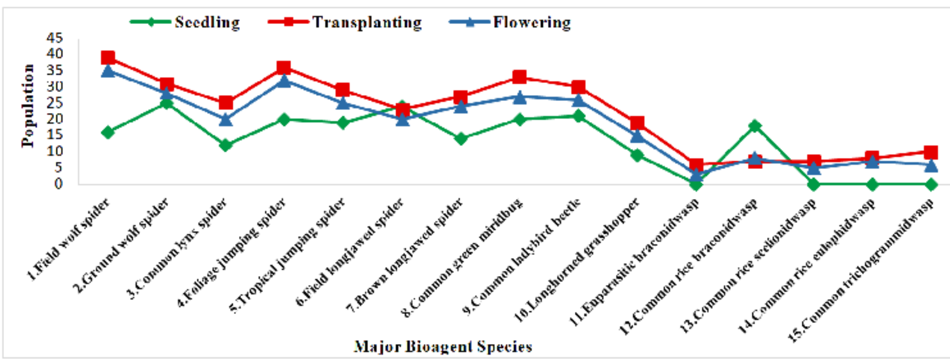

Fig. 2. Major Bioagents Population under Weather Parameters (Sum of 2014 & 2015).

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