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Impact of Bio-Fertilizers for the Management of Spot Blotch Disease and Growth and Yield Contributing Parameters of Wheat

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Seven bio-fertilizers *viz.*, *Azotobacter chroococum, PGPR, Trichoderma harzianum, Trichoderma viride, PSB, Rhizobium, carbendazim,* were evaluated in management of spot blotch of wheat and its role on growth parameters and yield. The maximum germination was recorded in case of seed treatment with Azotobacter (95 %). Highest shoot length (25.4, 47.9 and 74.4 cm) and root length (8.4, 10.1 and 11.80 cm) and maximum number of tillers (5.8, 6.3 and 7.30/plant) was achieved when wheat seeds were treated with *A. chroococcum* and soil application with *A. chroococcum* at 35, 55, 75 days. The highest fresh shoot and root weight was noted in *Azotobacter* treated plant as seed treatment and soil application with *A. chroococum*, representing 17.92 gm/shoot and 1.9 gm/root at 90 days age of plant. Seed treatment and soil application with bio-fertilizer of *Azotobacter* showed the minimum severity of disease with 42.60%. Higher grain (47.62 gm/pot) and straw yield (74.80 gm/pot) was obtained from *Azotobacter* treated plant.

Key words: Wheat, bio-fertilizers, spot blotch, management, growth parameters.

Wheat *(Triticum aestivum* L.) is one of the most important and widely cultivated food cereals at national and international level in terms of area and production. It is crop the most important staple food of about 36% of the world populations (Breimar & Graur 1995). Yield trials conducted by different breeding centers around the world have shown that the production of bread wheat is constrained by several biotic and abiotic stresses (Duveiller, 2004). The warmer parts of the world are mainly affected by many diseases and among these diseases. Spot blotch of wheat caused by *Bipolaris sorokiniana* (Sacc.) Shoem has been a major disease of wheat grown under high humidity subtropical climate (Duveiller, 2002; Roshyara *et al.*, 2009). The disease has a special significance in eastern Gangetic plains of South Asia that includes India, Nepal and Bangladesh (Joshi *et al.*, 2007). The average yield losses due to spot blotch in India were reported to be 17 percent (Saari, 1998). Since, wheat is generally grown in intensive cropping system; therefore, there is a need to supply the nutrients to the crops as in combination with organic source to maintain proper micro-climate for suitable growth and development of crop as in sustainable agriculture. Biofertilizer are recognized as important component of sustainable agriculture. These bio-fertilizers are used to inoculate cereal crops for increasing the growth, yield attributes and yield of the crop. The bio-fertilizers like *Azotobacter, Rhizobium*, PGR, *Trichoderma viride, Trichoderma harzianium*, phosphorus solubilizing bacteria, fix the

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atmospheric N resulted increase yields in different crops. (Dhawan *et al*., 2005; Kachroo and Razdan 2006). Therefore, the study was under taken in the present investigations as influence of bio-fertilizer on growth, yield and spot blotch disease incidence in wheat.

MATERIALS AND METHODS

The experiment was conducted in the glass house complex of Department of Plant Pathology, C.S. Azad University of Agriculture and Technology, Kanpur during *rabi* season 2012-14. All these bio-fertilizers were obtained from Department of Microbiology and Plant Pathology, C. S. Azad University of Agriculture & Technology, Kanpur.

Wheat seeds of cultivar *Golden Halna* were treated with bioformulation *Azotobacter* @ 2g/1kg of seed. 10gm Jaggery was also added to make slurry and mixed it with seed. Then the seeds were kept in shade for dry. On the other hands, seeds were also treated with bioformulation of *Trichoderma viride*, *Trichoderma harzianun*, *Rhizobium trifolii*, plant growth promoting *Rhizobacteria* and Phosphorus solubilizing bacteria @ 2g/1kg of the seeds by dipping the seed in prepared solution for 6 hours. Then the seeds were shaded dried at room temperature before sowing.

Effect of bio-fertilizers on germination and growth of wheat seedling

The treated seeds of variety '*Golden Halna*' were placed in the glasshouse in 30 cm earthen pots separately, which were previously filled with a mixture of sterilized sandy loam and farm yard manure in the ratio of 2:1. Ten treated seeds were placed in each pot and watered regularly. Three replications were kept for each treatment and three pots were sown with untreated seed served as control. At 30 days age of seedling bio fertilizers were applied in soil @ 10g/pot in their respective treatment of biofertilizer used as seed treatment with the exception of carbendazim treated pot and control pot. Oberservation on germination of seed, growth parameter of seedlings like shoot length, root length number of tillers/ plant were recorded at 35, 55 and 75 days age of plant. Observation on germination of seed was taken at 24 hrs up to 6 days. The percentage of germination was calculated as:-

Germination (%) =Number of germination seed/ Number of total of seed × 10

Growth parameter

Plant height

For this purpose, three plants were randomly selected from each plots. The shoot height was measured (in cm.) from the soil surface with the help of meter scale. Three replications were kept for each treatment. The average of three plants height was recorded for obtaining plant height and represented as cm.

Fresh weight

Seventy five days age of wheat, fresh plant's shoot and root were weight on an electronic balance and the data was recorded as gram.

Dry weight

The fresh shoot and root of seventy five days age of plant were dried in an oven at 70^0C until constant weight. It was then weighted on an electronic balance separately and the data was recorded as gram.

Tillering habit

Increase number of tiller per cent in the indication of higher yields. Total number of tiller/ plant was counted at 35, 55 & 75 days of sowing. The observations were taken at the same three places in each pots for counting the number of tillering, at complete germination stage. The total of all the three value in each pot was get mean tiller density at maximum tillering stage.

Disease severity

The disease severity was measured by spraying the plant with conidial suspension of *B. sorokiniana* @ 10^6conidia/ml. The spore suspension was prepared from seven days old culture of the pathogen. The plants were then covered with polythene bags for 48hrs to provide suitable moisture and humidity for growth and development of the pathogen. Three replications were kept for each treatment. The observation on disease severity was recorded at 90 days age of plant. Disease observations were recorded after 90 days of sowing. Ten leaves of wheat were randomly selected and Per cent disease index (PDI) was calculated. Leaves with no sign of infection received a score of zero while those with highest infection (*i.e.* with the 76 or above leaf blighted) received a score of IV. Similarly, leaves with 1-25, 26-50 and 51-75 per cent area covered with spot

blotch lesions received a score of I, II, III, respectively. The disease severity of individual plants was calculated by the following formula as given by Chenula and Singh, (1964).

$$\text{Disease severity} = \frac{\text{Class rating} \times \text{class frequently}}{\text{Total no of leaves} \times \text{maximum class}} \times 100$$

Effect of biofertilizers on yield parameter

The crop was harvested according to field maturity and makes it bundles for each treatment separately. After harvesting, the crops were left in the glass house complex for sun drying. The bundles were then brought to the threshing floor after 3-4 days of sun drying. The observation pertaining biological yield, gram yield and straw yields were calculated as per following procedure.

Biological yield

After sun drying, the total produce bundle from each net pot before threshing was weighed by spring balance in gm and converted into q/ha by multiplying the conversion factor (6.67).

Biological yield = Grain yield + Straw yield

Grain yield

After threshing, the grain yield from each net pot produce, the grain yield was obtained by weighing in g/pot and converted into/ ha by multiplying conversion factor (6.67).

Straw yield

The straw yield was calculated by subtracting grain yield g/pot from the biological yield (g/pot) of each net pot. Finally, it was converted in terms of (q/ha) by multiplying the conversing factor (6.67).

Yield

The cleaned grain was weighed in each net pot with the help of pan balance. The yield of wheat straw was out by subtracting the grain yield from total biological yield. Then it was converted into q/ha by the multiplying with conversion factor (6.67).

Then the harvest index was also estimated. It is the recovery of grain yield against total biological yield is termed as "Harvest index". The harvest index was calculated expressed in percentage with the help of following formula.

$$\text{Harvest index} = \frac{\text{Grain yield}}{\text{Biological yield}} \times 100$$

RESULTS AND DISCUSSION

Effect of bio-fertilizers on germination and Shoot and Root length

Wheat seeds are treated with bio-fertilizer *viz*. *A. chroococum, R. trifolii*, PGPR, *T. viride, T. hargenium,* PSB and *Carbendazim* to find out their effect on seed germination and growth parameter of wheat seedling. The result presented in table 1 indicated that the seed treated with bio-fertilizer significantly increased the germination percentage of wheat seed. The maximum germination was recorded in case of seed treatment with Azotobacter (95 %), followed by *Plant growth promoting Rhizobacteria* (92 %). It was also cleared that all other treatments significantly increase the germination percentage of seed over control. The maximum shoot length with 25.4, 47.9 and 74.4 cm at 35 days, 55 days and 75 days age of plant was achieved in treatments, where seeds were treated with *A. chrooccocum* and soil application with *A. chrooccocum* which was followed by PGPR treatment representing 25.00, 44.90 and 72.00 cm. The rest of treatments were also showing superior over control but inferior over *A.chroococum*, treated plants. Similarly, root length under different treatments is also enhanced by the activity of bio-fertilizer. The result presented in the Table 1 revealed that the highest root length was achieved when wheat seeds were treated with *A. chroococcum* and soil application with *A. chroococcum* showing 8.4, 10.1 and 11.80 cm at 35, 55 and 75 day age of plant. Among the treatment, the minimum root length was noticed in carbendazim treated plant showing 6.7, 7.8 and 8.5 cm root length at 35, 55 and 75 days age of plant. Shanmugaiah *et al.,* (2009) observed cotton seeds treated with *T. viride* increased seed germination, root and shoot length, fresh and dry weight and vigour index over control. Rasool Azarmi *et al.* (2011) also reported that seed germination rate was not affected by *Trichoderma* application, but shoot height, shoot diameter, shoot fresh and dry weight and root fresh and dry weight in tomato seedlings were increased significantly the soil amended by *Trichoderma sp*. T and *T. harzianum* T969 had marked increase in leaf number and leaf area.

Tillering habit

Seed treatment and soil application with bio-fertilizer *viz*. *A. chroococum, R. trifolii*, PGPR,

T. viride, *T. hargenium*, PSB and *Carbendazim* on tillering habit of wheat crop reaveled that number of tillers significantly influenced by bio-fertilizers (Table 2). The maximum number of tillers was recorded in the seed treatment and soil application with *Azotobacter* which are 5.8, 6.3 and 7.30/plant at 35, 55 and 75 days age of plant against control as 4.3, 4.6 and 4.7. The seed and soil application with PGPR treatment showing 5.5, 6.2 and 6.6 effective tillers at 35, 55 and 75 days age of plant, representing second highest among the treatments. Among the treatments, minimum numbers of tiller per plant was found in case of carbendazim treated plant.

Fresh and dry weight of shoot and root

It is evident from Table 3 showed that fresh and dry shoot and root weight of plant was significantly influenced by bio-fertilizer. The highest fresh shoot and root weight was noted in *Azotobacter* treated plant as seed treatment and soil application with *A. chroococum*, representing 17.92 gm/shoot and 1.9 gm/root at 90 days age of plant which was followed by PGPR(14.85 & 2.89g/ plant) and *T. harzianum* (14.80 & 2.87g /plant), respectively. The maximum dry shoot and root weight of plant was recorded in case of *Azotobacter* treated plant shows 2.19 gm and 1.94 gm, respectively which was followed by PGPR treated plant representing 1.98 gm and 1.85 gm dry shoot and root weight, respectively. The minimum dry shoot weight was noticed in case of control plant (1.36 gm/plant). Several other scientists were also reported that there was a positive effect of bio-fertilizers in increasing the height of the plant

Table 1. Effect of bio-fertilizers on shoot and root length of wheat at different days of interval

S. N.	Treatments	Shoot length of different days of interval			Root length of different days of interval			Germi nation %
		35 days	55 days	75 days	35 days	55 days	75 days	
1.	*Azotobacter chroococum*	25.40	47.90	74.40	8.4	10.10	11.80	95
2.	*PGPR*	25.20	46.80	73.50	7.6	9.20	10.30	92
3.	*Trichoderma harzianum*	25.20	46.80	73.20	7.5	9.10	10.10	90
4.	*Trichoderma viride*	25.00	45.40	73.20	7.3	9.00	9.80	88
5.	*PSB*	24.80	45.40	72.20	7.2	8.70	9.70	87
6.	*Rhizobium*	24.50	44.90	72.10	7.0	8.40	9.20	87
7.	*Carbendazim*	24.60	44.30	72.00	6.7	7.80	8.50	86
8.	*Control*	24.10	40.20	64.20	6.2	7.80	8.50	72
	SE(diff)	0.4041	0.8371	1.2696	0.4041	0.4619	0.5196	
	C.D. at 5%	NS	1.7743	2.6918	0.8569	0.9793	1.1017	

Table 2. Effect of bio-fertilizers on tillering habit of plant at different days

S. No.	Treatment	No. of Tiller at different days		
		35 days	55 days	75 days
1.	*Azotobacter chroococum*	5.80	6.30	7.30
2.	*PGPR*	5.50	6.20	6.60
3.	*Trichoderma harzianum*	5.30	5.80	6.00
4.	*Trichoderma viride*	4.90	5.80	5.60
5.	*PSB*	4.60	5.20	5.30
6.	*Rhizobium*	4.50	4.90	5.00
7.	*Carbendazim*	4.30	4.80	4.90
8.	*Control*	4.30	4.60	4.70
	SE(diff)	0.27207	0.3751	0.5721
	C.D. at 5%	0.5774	0.7957	1.1629

(Barik & Goswami, 2003, Kachroo and Razdan, 2006).

Disease severity

Disease severity is one of the important parameter for higher yield and increase crop production. The data, presented in Table 3, indicated that the seed treatment and soil application with bio-fertilizer significantly decreased the severity of spot blotch of wheat. The maximum severity of disease was recorded in case of seed treatment with *carbendazim*, representing the value of 72.50%. Seed treatment and soil application with bio-fertilizer of *Azotobacter* showed the minimum severity of disease with 42.60%. It is also cleared from the table that other treatments also significantly

decreased the severity disease of spot blotch of wheat. The finding of the result indicated that the *Azotobacter* is not only suitable bio-fertilizer but also a good bio pesticide for control of spot *blotch* of wheat. Alwathnani and Kahkashan (2012) reported that seed treatment with bioagents ***(****Aspergillus niger, Penicillium citrinum, Penicillium* sp. and *Trichoderma harzianum)* significantly increased plant height, fresh weight and dry weight of plant. They also found that increased content of chlorophyll and decrease the disease severity of Fusarium wilt in all treated plant. Hameedunnisa Begum (1998) reported that the seed treatment with a suspension culture of *Azotobacter* found effective to check the disease.

Effect of bio-fertilizers on yield parameters of wheat Biological, Grain and straw yield

The data presented in the table 4 showed that the highest biological yield was obtained from Azotobacter treated plant, showing the value of 121.94 gm/pot, followed by PGPR treated plant (120.25 gm/pot). The minimum with 118.92 gm/pot yield was recorded in the carbendazim treated plant. higher grain yield was obtained from *Azotobacter* treated plant which is 47.62 gm/pot and minimum grain with 44.73 gm/pot in case of *Carbendazim* treated plant. Similarly, highest and lowest straw yield were also obtained from *Azotobacter* (74.80 gm/pot) and carbendazim treated plant (73.68 gm/pot) respectively. Kachroo and Razdan (2006) reported that growth, nutrient and yield of wheat is influenced by bio-fertilizers and nitrogen. Avivi and Feldman (1982) observed that the bacterial inoculants increase in total number of gains per plant and grain weight. Bhattari and Hess (1993) reported that variable yield response of spring wheat due to inoculation with *Azospirillium* spp.

Table 3. Effect of bio-fertilizer on disease severity and fresh shoot weight & root weight of wheat at 90 days age of plant

S. No.	Treatment	Fresh shoot weight (g /plant)	Dry shoot weight (g /plant)	Fresh root weight (g /plant)	Dry root weight (g /plant)	Disease severity (%)
1.	*Azotobacter chroococum*	17.92	2.19	2.90	1.94	42.60
2	*PGPR*	14.85	1.98	2.89	1.85	48.40
3.	*Trichoderma harzianum*	14.80	1.95	2.87	1.72	66.80
4.	*Trichoderma viride*	14.75	1.83	2.85	1.65	68.80
5	*PSB*	14.35	1.78	2.80	1.62	70.20
6.	*Rhizobium trifollii*	14.01	1.76	2.80	1.56	70.25
7.	*Carbendazim*	13.88	1.46	2.78	1.48	72.50
8.	*Control*	13.41	1.36	2.78	1.14	73.70
	SE(diff)	0.57681	0.1125	0.0577	0.0632	1.6166
	C.D. at 5%	1.2240	0.2387	N.S.	0.1347	3.4274

Table 4. Effect of Bio-Fertilizers on Yield parameter of Wheat

S. No.	Treatment	Biological yield gm/pot	Grain yield gm/pot	Straw yield gm/pot	Harvest index %
1.	*Azotobacter chroococum*	121.94	47.62	74.80	39.09
2.	*PGPR*	120.38	46.97	74.64	39.05
3.	*Trichoderma harzianum*	120.25	46.57	74.32	38.72
4.	*Trichoderma viride*	120.15	46.50	74.25	38.62
5.	*PSB*	119.72	44.92	74.23	37,59
6.	*Rhizobium*	119.36	44.73	73.88	37.57
7.	*Carbendazim*	118.98	44.72	73.68	37.52
8.	*Control*	118.92	44.69	73.18	37.46
	SE (diff.)	0.8485	0.5774	0.5779	0.4676
	C.D. at 5 %	1.7991	1.2239	N. S.	0.9912

in Nepal. Yadav *et al.* (2000) also reported that yield of wheat is increased due to inoculation with Azotobacter.

Harvest index

The harvest index of wheat influenced significantly by application of bio-fertilizer. The highest harvest index with the value of 39.09 % of wheat was obtained from *Azotobacter* treated plant. Other treatments were also, showing superior over control in case of harvest index. Similarly harvest index was also found maximum 39.09 percent Azotobacter treated plant. The influence of FYM, nitrogen and bio-fertilizers on growth, yield attributes and yields of wheat under limited water supply.

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