Int.J.Curr.Microbiol.App.Sci (2019) *8*(9): 461-473

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 8 Number 09 (2019)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2019.809.056

Effect of Bio-Fertilizers and Flumioxazin on Microflora and Yield of Groundnut (*Arachis hypogaea* L.) in Alfisol of West Bengal

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Keywords

Biofertilizers, Flumioxazin, Groundnut, Herbicide, Microflora

Article Info

Accepted:
04 August 2019
Available Online:
10 September 2019

A B S T R A C T

Herbicide is the most important input in the modern agriculture. The use of herbicides has been expanding more rapidly than that of other pesticides. The injudicious application of herbicides in agriculture causes the contamination of the soil with toxic chemicals and become harmful to the microorganisms, plant, wildlife and man. In view of the above a field experiment was conducted during *rabi* season of 2015-16 with the groundnut variety TAG-24 with twenty four treatment combination in three replications. The result of this experiment showed that the application of herbicide Flumioxazin along with different combinations of biofertilizers PSB, *Rhizobium* and *Azotobacter* have no significant adverse effects in the physico-chemical properties of soil (pH and EC), available nitrogen content, microflora population (NFB, PSB, fungi, actinomycetes) and pod yield of Groundnut.

Introduction

Groundnut (*Arachis hypogaea* L.) is one of the principal economic oilseed crops in the world. It contains about 50% oil, 25-30% protein, 20% carbohydrate and 5% fibre and besides this, it also contains vitamin E, niacin, folacin, calcium, phosphorus, magnesium, zinc, iron, riboflavin, thiamine and potassium (Savage and Keenan, 1994), which make a substantial contribution to human nutrition. The oils not only acts as the essential part of human diet but also serve as an important raw materials for the agro-based industries and for the manufacturing of various sophisticated products.

The new approach for farming often referred to as 'sustainable agriculture" advocates the use of renewable inputs like biofertilizers, green manure, vermicompost etc. This is also important both from the view point of environmentally safe technologies and providing some sort of fertilizer to the resource-poor and marginal farmers. Seed inoculation with biofertilizer is a low cost

input which plays a significant role in crop yields and enhances nutrient availability to the crop plants.

Among the various biotic stresses resulting in low productivity, weeds are considered as a major constraint; especially under rainfed eco-systems. Weeds cause serious problems to the groundnut crop during the first 45 days of its growth. The most critical period of weed competition is from 3-6 weeks after sowing. The average yield loss due to weeds is about 30%, whereas under poor management yield loss by weeds may be 60% (Dayal *et al.,* 1987).

Use of herbicides for weed control in legumes and especially in groundnut has certainly contributed to the increased yield and improved quality. However, detrimental effects caused by these herbicides on soil microorganisms growth and metabolism have also been reported in several studies. Experiments carried out to evaluate the effect of different herbicides on the *Rhizobium* growth and nitrogen fixation activity revealed that the effect depends on the herbicide, its concentration, crop, nature and type of micro-organisms and different weather conditions (Sawicka and Selwet, 1998). Hence, unique combination of the above factors, which are very specific for a region, needs to be studied to predict the influence of the herbicides used on the growth and metabolism of micro-organisms. With this view, the present study was taken up to study the "Effect of Bio-fertilizers and Flumioxazin on microflora and yield of Groundnut (*Arachis hypogaea* L.) in alfisol of West Bengal".

Materials and Methods

Site of experiment

A field trial was conducted during *rabi* season of 2015-16 in Agricultural Research Farm, Institute of Agriculture, Visva-Bharati, Sriniketan located at 23°39'N latitude and87°42'E longitude with an altitude 58.9 m AMSL. The soil of the experimental site was sandy loam in texture, acidic in reaction (pH 4.8) with low level of organic carbon (0.42%) but medium level of available nitrogen (225.79 kg ha^{-1}), available P_2O_5 (43.68 kg ha^{-1}), available K_2O (138.7 kg ha^{-1}) and contained 9.37×10^4, 18.5×10^4, 16×10^4, 3×10^4 cfu g^{-1} NFB, PSB, fungi and actinomycetes, respectively. The groundnut crop variety TAG-24, a bunch type, Spanish, variety which is improved through selection and contains nearly 50% of oil, matures in 110 to 120 days if sown by the first week of February. It was sown during first week of February.

Experimental details

The experiment was carried out in a Randomized Block Design with factorial concept (FRBD) having two factor. Factor A having 3 treatments i.e. No herbicide (Ho), Recommended dose of herbicide (H_1) and Double dose of herbicide (H_2) and Factor B having 7 treatments i.e. Noinoculation (B_0),PSB (B_1), *Rhizobium* (Rhizo) (B_2), (B_3), *Azotobacter* (Azo) (B_4), PSB+*Rhizobium* (B_5), PSB+ *Azotobacter* (B_6), Rhizobium + *Azotobacter* (B_7), PSB+ *Rhizobium* +*Azotobacter* (B_8). The interaction between two factor A×B gives 24 treatments which is replicated thrice. Each plot was 3m x 4m surrounded by ridges. Adequate number of irrigation channels was constructed to provide irrigation independently to each plot.

Sampling and analysis

Ten plants were randomly selected from each plot and the number of pods from those plants, number of grains per pod and harvest index was determined after harvest. Soil samples were collect from the experimental plot after final harvest of the crop. Then the soil samples were dried in shade and processed in the laboratory and finally the individual test for

soil pH and EC, available nitrogen content and microbial population were estimated accordingly.

Results and Discussion

Effect of biofertilizers and flumioxazin on pod yield of groundnut

The result showed that the single inoculation of *Azotobacter* @ 80 g kg^{-1} of seed without any application of herbicide gave the remarkably highest pod yield (3416.67 kg ha^{-1}) after harvest of groundnut crop in alfisol of West Bengal followed by single inoculation of *Rhizobium* along with double the recommended dose of herbicide @ 500 g ha^{-1} (3175 kg ha^{-1}) and then followed by single inoculation of *Rhizobium* along with recommended dose of herbicide @ 250 g ha^{-1} (3091.67 kg ha^{-1}). The pod yield advantages due to single inoculation of *Azotobacter*, single inoculation of Rhizobium, dual inoculation of *Rhizobium* + *Azotobacter*, and dual inoculation of *Rhizobium* + PSB were 28.39, 24.05, 14.96 and 1.54%, respectively, over uninoculated control (2172.11 kg ha^{-1}), 32.80, 28.31, 18.91 and 5.03%, respectively, over dual inoculation of *Azotobacter*+ PSB (2099.99kg ha^{-1}), 42.61, 37.78, 27.69 and 12.78%, respectively, over combined inoculation of *Rhizobium* +*Azotobacter* + PSB (1955.55 kg ha^{-1}) and 67.33, 61.67, 49.83 and 32.33%, respectively, over single inoculation of PSB (1666.66kg ha^{-1}) at harvest of the crop.

Single inoculation of seeds with *Azotobacter* significantly increased the mean pod yield (2788.88kg ha^{-1}) in groundnut. This was followed by seed inoculation with *Rhizobium* alone (2694.44 kg ha^{-1}) and dual inoculation of *Rhizobium* + *Azotobacter* (2497.11kg ha^{-1}), irrespective of herbicide application. The yield increments might be due to improvement in number of different microbial as well as total microbial population, improvement of favourable soil physico-chemical properties and increase of available nitrogen. Shashidhar *et al*., (2009), Narula *et al.,* (2000) reported significantly higher yield and total microbial population due seed inoculation with biofertilizers and their different combinations along with recommended dose herbicide (Table 1).

Effect of biofertilizers and flumioxazin on phsico-chemical properties of groundnut cropped soil

Effect on soil pH and EC

The result showed that either in the single seed inoculation of *Rhizobium*, PSB and *Azotobacter* or the different combinations of *Rhizobium*, PSB and *Azotobacter* inoculation combined with different levels of herbicide H_0,H_1, H_2 gave more or less same results of soil pH after harvest of groundnut. There was no significant difference found among the treatments.

The result showed that single inoculation of *Azotobacter* @ 80 g kg^{-1} seeds along with double RD of herbicide @ 500 g ha^{-1} increased the EC of soil after harvest of groundnut crop in alfisol of West Bengal followed by combined inoculation of PSB+*Rhizo*+ *Azotobacter* along with double RD of herbicide and PSB+ *Rhizo*+ *Azotobacter* along with RD of herbicide and then followed by uninoculated control (Table 2). These results corroborated with the earlier findings of Sumathi *et al.,* (2012).

Effect on available nitrogen content

The effect of herbicide and seed inoculation on available nitrogen content was found significant (Table 3). Interaction effect of *Azotobacter* @ 80 g kg^{-1} seed along with double recommended dose of herbicide @ 500 g ha^{-1} gives significantly higher nitrogen

content (561.97 kg ha^{-1}) followed by combined inoculation of PSB+*Rhizobium* +*Azotobacter* @ 80 g kg^{-1} seed without application of any herbicide (549.43 kg ha ˉ1) and Single inoculation of *Rhizobium* @ 80 g kg^{-1} seed along with recommended dose of herbicide @ 250 g ha^{-1} and Single inoculation of *Azotobacter* @ 80 g kg^{-1} seed along with recommended dose of herbicide @ 250 g ha^{-1} (524.34 kg ha^{-1}) in respect of all the treatments of herbicides irrespective of doses.

Based on these results obtained from the study it could, thus, be concluded that seed inoculation with different strains of biofertilizers along with herbicide may be an effective recommendation for better nitrogen management in groundnut plot. These results corroborated with the earlier findings of Usha *et al.,* (2004) in Kinnow mandarin.

Effect of biofertilizers and flumioxazin on microbial population of groundnut cropped soil

Effect on bacteria in soil

The result showed that combined inoculation of *Rhizobium* + *Azotobacter* + *PSB* @ 80 g kg^{-1} of seeds along without application of herbicide gave significantly the highest number of Nitrogen fixing bacterial (NFB) at 60 DAS over initial NFB population (9.37 x 10^4 cfu g^{-1}) (Table 4) and the dual inoculation of *Rhizobium* + *Azotobacter* @ 80 g kg^{-1} of seeds along without application of herbicide gave the highest number of Phosphate solubilizing bacterial (PSB) population at 60 DAS over initial PSB population (18.5 x 10^4 cfu g^{-1}) in groundnut field in alfisol of West Bengal (Table 5).

These results were in agreement with the earlier findings of Kunc *et al.,* (1985), Taiwo and Oso (1997) in soil in respect to increase of NFB and PSB population.

Effect on fungi population in soil

The effect of interaction between herbicide and seed inoculation on fungal population was not found significant (Table 6) particularly at 15 DAS and 90 DAS onward of groundnut. The highest number of fungal population (46.50 x 10^4 cfu g^{-1}) was recorded in the treatment of PSB @ 80 g kg^{-1} of seed inoculation without any herbicide application at 30 DAS as compared to uninoculated control (31.52x 10^4 cfu g^{-1}) followed by dual inoculation of PSB+*Azotobacter* @ 80 g kg^{-1} seed along with recommended dose of herbicide @ 250g ha^{-1} (42.9x 10^4 cfu g^{-1}). Based on these results obtained from the study it could, thus, be concluded that seed inoculation with different strains of biofertilizers with or without recommended dose of herbicide would be an effective recommendation for better crop management in groundnut in respect of better decomposition of organic matter as well as fertilizers due to increase of fungal population is soil. These results were in agreement with the earlier findings of Kunc *et al.*, (1985) and Taiwo and Oso (1997) in soil in respect to increase of fungal population.

Effect on actinomycetes population in soil

The results showed that single inoculation of *Azotobacter* along with recommended dose of Flumioxzin @ 250 g ha^{-1} (Fig. 1) gave the highest number of Actinomycetes population at 30 DAS of groundnut in alfisol of West Bengal followed by without any application of biofertilizers along with recommended dose of herbicide @ 250 g ha^{-1} at 60 DAS and without any application of biofertilizers along with double recommended dose of herbicide @ 500 g ha^{-1} at 30 DAS (Table 7). Based on these results obtained from the study it could, thus, be concluded that seed inoculation with different strains of biofertilizers with recommended dose of herbicide would be an

effective recommendation for better crop management in groundnut in respect of better decomposition of organic matter as well as fertilizers due to increase of actinomycetes population is soil. These results were in agreement with the earlier findings of Kunc *et al.*, (1985) and Taiwo and Oso (1997) in soil in respect to increase of actinomycetes population.

Effect on total microflora in soil

The results showed that dual inoculation of *Rhizobium* + *Azotobacter* gave significantly highest number of microflora at 60DAS of groundnut in the alfisol of West Bengal without application of herbicide followed by dual inoculation of biofertilizer of *Rhizobium* + *Azotobacter* along with double the recommended dose of Flumioxzin @ 500 g ha^{-1} and dual inoculation of Rhizobium +PSB along with recommended dose of Flumioxazin @ 250 g ha^{-1} (Table 8). These results were in agreement with the earlier findings of Kunc *et al.*, (1985) and Taiwo and Oso (1997) in soil in respect to increase of total microbial population.

Table.1 Effect of biofertilizers and flumioxazin on pod yield of groundnut

Yield (kg ha^{-1})				
Treatments	***HARVEST**			
Biofert/ Herbicide	H_0	H_1	H_2	Mean
Control	2441.33	1633.33	2441.67	2172.11
PSB	958.33	2741.67	1300.00	1666.66
Rhizo	1816.67	3091.67	3175.00	2694.44
Azo	3416.67	2216.67	2733.33	2788.88
PSB+Rhizo	2191.67	2675.00	1750.00	2205.55
PSB+Azo	1933.33	1841.67	2525.00	2099.99
Azo+Rhizo	2408.22	2350.00	2733.11	2497.11
PSB+Azo+Rhizo	1450.00	1366.67	3050.00	1955.55
Mean	2077.03	2239.58	2463.51	
S.Em(±)	110634.76			
CD 5% for H	193.20			
B	315.62			
HB	546.60			
CV %	14.72			

*****Average of the three replication

Table.2 Effect of biofertilizers and flumioxazin on pH and EC of soil after harvest of groundnut

	Soil pH					Soil EC (msm^{-1})				
Treatments	***Initial**	***HARVEST**				***Initial**	***HARVEST**			
Biofert/Herbicide	4.5	H_0	H_1	H_2	Mean	1.0	H_0	H_1	H_2	Mean
Control		4.53	4.45	4.53	4.50		1.37	0.92	1.07	1.12
PSB		4.50	4.41	4.75	4.55		1.19	1.08	0.97	1.08
Rhizo		4.37	4.64	4.44	4.48		0.88	1.06	0.96	0.97
Azo		4.53	4.48	4.35	4.45		1.35	1.31	1.93	1.53
PSB+Rhizo		4.79	4.38	4.48	4.54		0.89	0.95	1.25	1.03
PSB+Azo		4.47	4.41	4.43	4.43		0.70	1.30	0.65	0.88
Azo+Rhizo		4.47	4.51	4.46	4.48		1.02	1.28	0.92	1.07
PSB+Azo+Rhizo		4.43	4.38	4.37	4.39		1.16	1.55	1.55	1.42
Mean		4.51	4.45	4.47			1.07	1.18	1.16	
S. Em(±)	0.213					0.02				
CD 5% for H	NS					0.082				
B	NS					0.134				
HB	NS					0.232				
CV %	10.30					12.42				

***Average of the three replication

Table.3 Effect of biofertilizers and flumioxazin on available soil nitrogen

	Available Nitrogen (kg ha^{-1}) [Average of the three replication]				
Treatments	**Initial**	**Harvest**			
Biofert/Herbicide	225.79	H_0	H_1	H_2	Mean
Control		402.24	436.53	423.99	420.92
PSB		486.71	373.81	336.18	398.90
Rhizo		436.53	524.34	476.16	478.34
Azo		411.44	524.34	561.97	499.25
PSB+Rhizo		411.44	361.27	411.44	394.72
PSB+Azo		348.72	386.36	386.36	373.81
Azo+Rhizo		411.44	398.90	361.27	390.54
PSB+Azo+Rhizo		549.43	449.08	323.64	440.71
Mean		432.24	431.82	409.87	
S. Em (±)	3296.38				
CD 5% for H	33.36				
B	54.48				
HB	94.36				
CV %	13.52				

Table.4 Effect of biofertilizers and flumioxazin on NFB population

Treatments	NFB Population																			
	*Initial (No.×10^4 $cfug^{-1}$)	*15 DAS (No.×10^4 $cfug^{-1}$)				*30DAS (No.×10^5 $cfug^{-1}$)				*60DAS (No.×10^5 $cfug^{-1}$)				*90 DAS (No.×10^5 $cfug^{-1}$)				*HARVEST (No.×10^4 $cfug^{-1}$)			
Biofert/ Herbicide		H_0	H_1	H_2	Mean	H_0	H_1	H_2	Mean	H_0	H_1	H_2	Mean	H_0	H_1	H_2	Mean	H_0	H_1	H_2	Mean
Control	9.37	6	13	58.25	25.75	3.8	2.85	3.75	3.47	30.07	17.40	25.40	24.29	7.42	7.17	6.55	7.05	11	8	28.5	15.83
PSB		36.25	11.25	45.72	31.08	3.5	6.78	3.57	4.62	15.85	33.70	21.85	23.8	7.30	3.85	4.62	5.26	18.5	3.5	4.5	8.83
Rhizo		4	40.5	23.5	22.67	6.4	13.32	3.17	7.63	24.50	39.65	21.67	28.61	10.65	7.70	6.67	8.34	5.5	28.5	17.5	17.17
Azo		20.75	45.5	36.25	34.17	6.7	4.7	7.55	6.32	13.80	22.70	19.77	18.76	2.15	9.27	5.82	5.75	16	40	12	22.67
PSB+Rhizo		10.25	21.5	13.5	15.08	3.6	4.65	5	4.42	31.07	39.75	18.52	29.78	8.27	11.12	4.07	7.82	9	26.5	16	17.16
PSB+Azo		74	11.5	15.25	33.58	1.9	3.80	3.65	3.12	17.60	23.80	30.47	23.96	6.60	4.85	8.30	6.58	16	16	8.5	13.5
Azo+Rhizo		14.75	39.75	50	34.83	5.55	4.07	5.07	4.90	19.97	24.47	18.90	21.12	10.05	8.62	7.52	8.73	6.33	17	2	8.44
PSB+Azo+ Rhizo		25.25	56.5	25.75	35.83	4.525	4.97	3.92	4.48	42.58	23.02	26.10	30.57	8.97	7.90	5.45	7.44	11	35	15	20.33
Mean		23.91	29.94	33.53		4.50	5.64	4.46		24.43	28.06	22.84		7.68	7.56	6.13		11.67	21.81	13	
S.Em(±)		2.280				0.358				2.449				1.012				1.133			
CD 5% for H		0.435				0.172				0.451				0.290				0.307			
B		0.711				0.282				0.737				0.474				0.501			
HB		1.233				0.488				1.277				0.821				0.869			
CV %		**5.185**				**12.30**				**6.23**				**14.13**				**6.87**			

*****Average of the three replication

Table.5 Effect of biofertilizers and flumioxazin on PSB population

PSB Population																				
Treatments	***Initial (No.×10^4 cfug^{-1})**	***15 DAS (No.×10^5 cfug^{-1})**				***30DAS (No.×10^5 cfug^{-1})**				***60DAS (No.×10^7 cfug^{-1})**				***90 DAS (No.×10^5 cfug^{-1})**				***HARVEST (No.×10^5 cfug^{-1})**			
Biofert/ Herbicide		**H_0**	**H_1**	**H_2**	**Mean**	**H_0**	**H_1**	**H_2**	**Mean**	**H_0**	**H_1**	**H_2**	**Mean**	**H_0**	**H_1**	**H_2**	**Mean**	**H_0**	**H_1**	**H_2**	**Mean**
Control	18.5	7.22	5.85	2.63	5.24	12	15.83	28.31	18.71	3.62	18.67	24.15	15.48	7.62	9.14	9.70	8.82	10.50	7.45	9.40	9.12
PSB		4.25	3.67	3.6	3.84	14.74	15.34	7.52	12.54	11.87	21.38	12.22	15.16	6.90	7.82	5.95	6.89	11.60	12.05	5	9.55
Rhizo		4.2	5.05	5.67	4.97	11.50	12.62	11.60	11.91	23.27	20.42	16.57	20.09	7.37	10.79	8.40	8.85	7	2.9	8.8	6.23
Azo		6.58	6.55	4.35	5.83	18.95	10.42	17.50	15.62	22.92	25.12	22.85	23.63	9.70	14.72	13	12.47	5.95	1.35	6.5	4.6
PSB+Rhizo		4.85	2.52	5.96	4.44	20.23	25.72	28.43	24.79	20.42	29.68	28.67	26.26	13.92	12.67	5.35	10.65	6.25	6.9	5.5	6.22
PSB+Azo		3.62	9.51	4.2	5.78	11.93	19.30	23.72	18.32	9.12	19.85	23.95	17.64	4.15	16.65	9.92	10.24	5.15	10.15	6.10	7.13
Azo+Rhizo		5.16	2.87	10.05	6.03	12.76	12.15	15.63	13.51	33.40	10.35	31.03	24.92	5.92	6.30	6.75	6.32	6.75	6.75	5.25	6.25
PSB+Azo+ Rhizo		3.85	5.85	8.37	6.02	34.17	16.52	11.84	20.84	28.07	18.17	23.85	23.37	7.55	6.82	6.35	6.91	5.7	6.3	12.70	8.23
Mean		4.97	5.24	5.60		17.04	16.00	18.07		19.09	20.46	22.91		7.90	10.61	8.18		7.36	6.73	7.41	
S.Em(±)		0.341				1.74				1.566				0.443				0.770			
CD 5% for H		0.168				0.381				0.361				0.192				0.253			
B		0.275				0.622				0.590				0.313				0.413			
HB		0.477				1.078				1.021				0.543				0.716			
CV %		**11.08**				**7.75**				**6.012**				**7.482**				**12.245**			

***Average of the three replication

Table.6 Effect of biofertilizers and flumioxazin on fungi population

Treatments	Fungi Population																			
	*Initial (No.×10^4 $cfug^{-1}$)	*15 DAS (No.×10^4 $cfug^{-1}$)				*30DAS (No.×10^4 $cfug^{-1}$)				*60DAS (No.×10^4 $cfug^{-1}$)				*90 DAS (No.×10^4 $cfug^{-1}$)				*HARVEST (No.×10^4 $cfug^{-1}$)			
Biofert/ Herbicide		H_0	H_1	H_2	Mean	H_0	H_1	H_2	Mean	H_0	H_1	H_2	Mean	H_0	H_1	H_2	Mean	H_0	H_1	H_2	Mean
Control	16	6.67	2.67	10	6.44	31.52	2.6	23.30	19.14	5.33	3.12	5.25	4.57	6.5	4	4.5	5	3	3.5	11.5	6
PSB		3.92	7.33	7.83	6.36	46.50	6.8	22.75	25.35	3.50	6.87	9.37	6.58	3	6.5	2.5	4	18	6	1	8.33
Rhizo		13.25	6.58	6.50	8.78	9.10	14.5	4.40	9.33	7.12	6.12	1.87	5.04	7.5	20.5	5	11	2.5	2	9.5	4.67
Azo		4	8.58	5	5.86	3.4	16.7	12.65	10.92	4	13.5	4.87	7.46	5.5	5	2.67	4.39	2	3.5	5.5	3.67
PSB+Rhizo		7.5	8	39.5	18.33	14.65	10.75	5.80	10.4	5.62	3	5.87	4.83	5.5	2	18	8.5	9	1	15.5	8.5
PSB+Azo		5.25	3	5.25	4.5	3.5	42.9	10.55	18.98	4.12	2.62	4	3.58	4.5	16.67	1	7.39	4.5	8	7.5	6.67
Azo+Rhizo		3.75	6	6.75	5.5	16.4	15.13	5.45	12.33	1.5	4.37	11.25	5.71	1.5	6.5	16	8	6	4.5	2.5	4.33
PSB+Azo+Rhizo		14	2.25	6.25	7.5	13	13.6	6.95	11.18	8.75	36	1.75	15.5	11.5	18.33	3	10.94	3	12	4	6.33
Mean		7.29	5.55	10.88		17.26	15.37	11.48		4.99	9.45	5.53		5.69	9.94	6.58		6	5.06	7.12	
S.Em(±)		1.068				0.950				0.609				0.731				0.442			
CD 5% for H		0.298				0.281				0.225				0.246				0.191			
B		0.487				0.459				0.367				0.403				0.313			
HB		0.843				0.795				0.637				0.698				0.542			
CV %		**13.066**				**6.628**				**11.71**				**11.55**				**10.97**			

*****Average of the three replication

Table.7 Effect of biofertilizers and flumioxazin on actinomycetes population

Actinomycetes Population																				
Treatments	***Initial (No.×10^4 cfug^{-1})**	***15 DAS (No.×10^4 cfug^{-1})**				***30DAS (No.×10^4 cfug^{-1})**				***60DAS (No.×10^5 cfug^{-1})**				***90 DAS (No.×10^4 cfug^{-1})**				***HARVEST (No.×10^4 cfug^{-1})**			
Biofert/ Herbicide		**H_0**	**H_1**	**H_2**	**Mean**	**H_0**	**H_1**	**H_2**	**Mean**	**H_0**	**H_1**	**H_2**	**Mean**	**H_0**	**H_1**	**H_2**	**Mean**	**H_0**	**H_1**	**H_2**	**Mean**
Control	3.0	8.6	8.25	9.5	8.78	33	28.5	132	64.5	0.70	18.70	3	7.47	14	8.5	15	12.5	9.5	7	10	8.83
PSB		7.3	5.45	8.90	7.22	59.50	33.50	35	42.67	1.20	1.25	5.80	2.75	14	31	17	20.67	6.5	6	6	6.17
Rhizo		9.65	6.75	8.88	8.43	37.50	19.50	34	30.33	6.05	11.20	10.60	9.28	24.5	25.5	50	33.33	3.5	14.5	8	8.67
Azo		12.25	10.05	10.25	10.85	74.50	195	20.50	96.67	9.60	1	2.10	4.23	10	11.5	22	14.5	2.5	8	0.5	3.67
PSB+Rhizo		6.5	50	14.75	23.75	51.50	17	30.50	33	3.50	5.65	0.45	3.2	2.5	54.5	8	21.67	7.5	3.5	4	5
PSB+Azo		9.65	11.20	17.55	12.8	33.50	37	34.50	35	9.55	0.25	0.35	3.38	12	5	39.5	18.83	8	2.5	2	4.17
Azo+Rhizo		9.85	3.60	49.95	21.13	96.50	61	30	62.5	1.45	2.65	0.25	1.45	28	14.5	6	16.17	1	8.5	9	6.17
PSB+Azo+Rhizo		9.20	8.25	13.50	10.32	62.50	62	44.50	56.33	8.10	3.55	5	5.55	9	4	33.5	15.5	2.5	3	1	2.17
Mean		9.12	12.94	16.66		56.06	56.69	45.12		5.02	5.53	3.44		14.25	19.31	23.87		5.12	6.62	5.06	
S.Em(±)		0.669				15.303				0.746				2.993				0.245			
CD 5% for H		0.236				1.129				0.249				0.499				0.142			
B		0.385				1.844				0.407				0.815				0.233			
HB		0.667				3.194				0.705				1.412				0.404			
CV %		**6.34**				**7.43**				**18.51**				**9.036**				**8.832**			

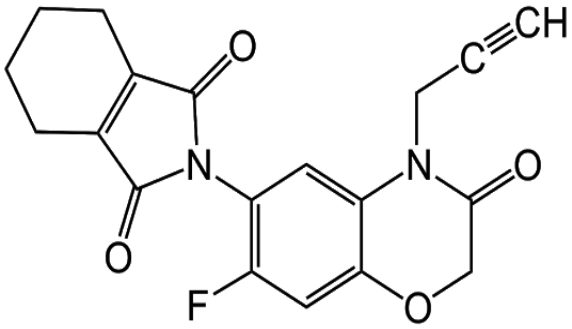
*****Average of the three replication

Table.8 Effect of biofertilizers and flumioxazin on microflora population

Treatments	Microflora Population																			
	*Initial (No.×10^4 $cfug^{-1}$)	*15 DAS (No.×10^5 $cfug^{-1}$)				*30DAS (No.×10^5 $cfug^{-1}$)				*60DAS (No.×10^7 $cfug^{-1}$)				*90 DAS (No.×10^5 $cfug^{-1}$)				*HARVEST (No.×10^5 $cfug^{-1}$)			
Biofert/ Herbicide		H_0	H_1	H_2	Mean	H_0	H_1	H_2	Mean	H_0	H_1	H_2	Mean	H_0	H_1	H_2	Mean	H_0	H_1	H_2	Mean
Control	46.87	9.33	8.24	10.40	9.33	22.25	21.79	47.59	30.54	3.94	19.03	24.44	15.80	17.10	17.57	18.20	17.62	12.85	9.30	14.40	12.18
PSB		8.98	6.08	9.85	8.31	28.84	26.14	16.87	23.95	12.05	21.73	12.51	15.43	15.90	15.42	12.52	14.62	15.90	13.60	6.15	11.88
Rhizo		6.89	10.43	9.56	8.96	22.56	29.35	18.62	23.51	23.59	20.93	16.90	20.47	21.22	23.09	20.57	21.63	8.15	7.40	12.30	9.28
Azo		10.28	12.96	9.50	10.92	33.44	36.29	28.36	32.7	23.16	25.38	23.07	23.87	13.40	25.64	21.29	20.11	8.00	6.50	8.3	7.6
PSB+Rhizo		7.27	10.47	12.73	10.16	30.44	33.15	37.06	33.55	20.78	30.13	28.88	26.59	23	29.45	12.02	21.49	8.8	10.00	9.05	9.28
PSB+Azo		12.51	12.09	8.00	10.87	17.53	31.09	31.89	26.83	9.40	20.09	24.26	17.92	12.40	23.67	22.27	19.45	8.00	12.80	7.90	9.57
Azo+Rhizo		8.00	7.81	20.72	12.18	29.60	23.84	24.91	26.12	33.62	10.62	31.23	25.16	18.92	17.02	16.47	17.47	8.08	9.75	6.60	8.14
PSB+Azo+Rhizo		8.69	12.55	12.92	11.39	46.25	29.06	20.91	32.07	28.59	18.48	24.16	23.74	18.57	16.96	15.45	17.00	7.35	11.30	14.70	11.12
Mean		9.00	10.08	11.71		28.86	28.84	28.28		19.39	20.80	23.18		17.56	21.10	17.35		9.64	10.08	9.92	
S.Em(±)		0.902				4.571				6.542				4.335				1.241			
CD 5% for H		0.274				0.617				0.738				0.601				0.321			
B		0.447				1.007				1.205				0.981				0.525			
HB		0.775				1.745				2.088				1.70				0.909			
CV %		**9.253**				**7.459**				**12.11**				**11.15**				**11.28**			

*****Average of the three replication

Fig.1 Structure and properties of flumioxazin



Common Name	Flumioxazin
Chemical Name	2-[7-fluro-3,4-dihydro-3-oxo-4-(2-propynyl)-2H-1,4 Benzoxazin-6-yl]-4,5,6,7-tetrahydro-1H-isoindole-1,3(2H)-dione
Chemical Family	N-phenylphthalimide derivative
Water solubility	1.78 mg/L @25^{0}C
Vapor pressure	2.41×10^{-6} mm Hg @22^{0}C
Molecular Formula	$C_{19}H_{15}FN_2O_4$
Molecular Weight	354.34
Melting Point	201.8 – 203.8^{0}C
Odor	Odorless
Formulation	Water dispersible granular
Percent Active ingredient	51.1%
Appearance	Light brown solid granules
Oxidizing or Reducing Action	No oxidizing or reducing properties
pH	5.4 at 25^{0}C, 1% suspension
Corrosion Characteristics	Not corrosive to containers

It can be concluded from the result of this experiment, that the application of herbicide Flumioxazin along with different combinations of biofertilizers PSB, *Rhizobium* and *Azotobacter* have no significant adverse effects in the physico-chemical properties of soil (pH and EC), available Nitrogen content, microflora population (NFB, PSB, fungi, actinomycetes) and pod yield of Groundnut. Seed inoculation with biofertilizers in combination with different doses of flumioxazin significantly increase NFB, PSB, Fungi and Actinomycetes population -78.67 to 277.33%, -27.03 to 586.49%, -93.75 to 12.5%, -83.33 to 383.33% after harvest of groundnut, respectively as against the initial population counts and the pod yield after harvest of groundnut.

References

Dayal, Devi, Basu, M.S. and Reddy, P.S. 1987. Fertilizer use in groundnut. Technologies for better crops. Technical Bulletin no. 30, New Delhi, Indian Council of Agricultural Research: pp. 1-7.

Kunc F., Tichy P. and Vancura, V. 1985. 2,4-dichlorophenoxy acetic acid in the soil: Mineralization and changes in the counts of bacteria decomposers. Versailles Ed. INRA Publication. (Les Colloques de I'NRA No. 31).

Narula, N., Kumar, V., Behi, R., Deubel, A., Granse, A. and Merbach, W. 2000. Effect of P-solubilising (*Azotobacter chroococcum*) on N, P, K uptake in P responsive wheat genotypes grown under greenhouse condition. Journal of Plant Nutrition and Soil Science. 163 (4): 393-398.

Savage, G. P. and Keenan, J. I. 1994. The composition and nutritive value of groundnut kernels. In *The Groundnut Crop: Scientific Basis for Improvement*, pp. 173– 213. Ed. J. Smart. London, UK: Chapman and Hall.

Sawicka, A and Selwet, A 1998. Effect of

active ingredients on Rhizobium and Brady rhizobium legume dinitrogen fixation. Polish Journal of Environmental Studies. 7(5): 317- 320

Shashidhar, K.R., Narayanswamy, T.K., Bhaskar, R.N., Jagadish, B.R., Mahesh, M. and Krishra, K.S. 2009. Influence of organic nutrients on soil health and mulberry (*Morus indica* L.) Production. Journal of Biological Sciences. 1(1): 94-100.

Sumathi, T., Janardhan, A., Srilakhmi, A., Sai Gopal, D.V.R and Narasimha, G. 2012. Impact of indigenous Microorganisms on Soil Microbial and Enzyme Activities. Archives of Applied Science Research. 4(2): 1065-1073.

Taiwo, L. B. and Oso, B. A. 1997. The influence of some pesticides on soil microbial flora in relation to changes in nutrient level, rock phosphate solubilisation and P-release under laboratory conditions. Agriculture, Ecosystem and Environment. 65(1): 59-68

Usha, K., Saxena, A. and Singh, B. 2004. Rhizosphere dynamics influenced by arbuscular mycorrhizal fungus (*Glomus deserticola*) and related changes in leaf nutrient status and yield of Kinnow mandarin x Willow leaf. Australian Journal of Agricultural Research. 55(5): 571-576.

How to cite this article:

Manasi Sahoo, Soumi Mukhopadhyay and Pabitra Kumar Biswas. 2019. Effect of Bio-Fertilizers and Flumioxazin on Microflora and Yield of Groundnut (*Arachis hypogaea* L.) in Alfisol of West Bengal. *Int.J.Curr.Microbiol.App.Sci.* 8(09): 461-473.
doi: https://doi.org/10.20546/ijcmas.2019.809.056