Original Research Article

EFFECT OF DIFFERENT LEVELS OF PSB AND ORGANIC STARTER SOLUTION ON GROWTH AND YIELD OF BROCCOLI (*Brassica oleracea* var. ~~*italica*~~*Italica*L.) c v. Lucky

ABSTRACT

Thepresent investigation entitled "EFFECT OF DIFFERENT LEVELS OF PSB AND ORGANIC STARTER SOLUTION ON GROWTH AND YIELD OF BROCCOLI" wasconductedintheHorticultureResearchFarm,DepartmentofHorticulture, Naini AgriculturalInstitute, Sam Higginbottom University ofAgricultureTechnology and Science, Prayagraj (UP) ~~During~~ inOctober 2021 to February 2022. Theexperiment was laid out in RBD with 9 treatments with 3 replications. The results revealedthat ~~Treatment T_8 (~~40ml/PlantPSB + 40ml/Plant Starter Solution TA41 (Diluted)~~)~~ performed the best in terms of days to Plant Height (30.56),and Leaf length (46.86), Leaf width(16.71),~~No. of Leaves~~Leaf Number (14.89), Days to initiation (49.5), Head weight (530g),Head yield perplot (3.22Kg), Head yield per hectare (14.6t/ha), B:C Ratio (4.9). Therefore, ~~the TreatmentT_8 (~~40ml/Plant PSB + 40ml/Plant Starter Solution TA41 (Diluted)~~)~~ is the best whencomparedtoothertreatments.As,thehighestcost-~~benefitcost~~benefitratiowasobserved intreatment~~T_8(~~40ml/Plant PSB + 40ml/PlantStartersolutionTA41 (Diluted)~~)~~ i.e., (4.9) whichstatesthat it is economicallyprofitablecomparedto all other treatments.

Keywords:Broccoli,Growth,yield,PSB,Startersolution

1. INTRODUCTION

Broccoli (*Brassica oleraceae*var.~~*italica*~~*Italica*) belongs to the genus Brassica and the family ~~Brassicacea~~ Brassicaceaewhich includes a wide range of crop plants derived from the Mediterranean sea and modified over the years by selection and breeding (**Decoteay, 2000**). Broccoli is often boiled or steamed but may be eaten raw.~~P-solubilization~~The p-solubilization ability of rhizosphere

microorganisms is considered to be one of the most important traits associated with plant phosphate nutrition. Phosphate solubilizing bacteria play an important role in supplementing phosphorous to ~~plant~~ plants allowing sustainable use of phosphate.PSB (Phosphate Solubilizing Bacteria) are beneficial bacteria capable of solubilizing inorganic phosphorus from insoluble compounds.

Starter ~~solution~~ solutions are mixtures of soluble fertilizer and water used to get young plants off to a good start. Improvement in broccoli growth and yield under starter solution was observed by(**Roy *et al.*,2010**). The starter solution supplies readily available nutrients directly to the soil-rhizosphere system.

2. MATERIALS AND METHOD

The experiment was conducted at Experimental Research Field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, and Prayagraj (UP) ~~during~~ in2021.Broccoli was planted in the field at a spacing of 60cm×45cm in a plot of 1m×1.5m size PSB (Phosphate Solubilizing Bacteria) and organic starter solution (TA41).Normal cultural and plant protection measureswere followed during the cultivation process. Plants were selected randomly from each plot asa representativesampleforrecordingdata.

The experiment considered of nine treatmentswith T_0 Control, $T_1$20ml/plant PSB (diluted), $T_2$40ml/plant PSB (diluted), $T_3$20ml/plant starter solution TA41(diluted), $T_4$40ml/plant starter solution TA41(diluted), $T_5$20 ml/pant PSB+ 20ml/Plant Starter SolutionTA41 (diluted), $T_6$20ml/plant PSB+ 40ml/Plant Starter solutionTA41 (diluted), $T_7$40ml/plant PSB+ 20ml/Plant Starter solutionTA41 (diluted), T_8 40ml/plant PSB +40ml/Plant Starter solution TA41(diluted)was laid out in randomized block design with three replications.

3. RESULT AND DISCUSSION

The broccoli results of the growth and yield ~~was~~ wereтaken and presented

Data ~~was~~ werecompared between the treated plots and the control to find out the best possible combination of PSB and Organic starter solution. The findings are given below:

Comment [S1]: Kindly put the citation...

Comment [S2]: Please elaborate on the starter used in this research (TA41)...what nutrient it contained...

Comment [S3]: The discussion should mention the plant metabolism that occurs due to the administration of PSB and the content of the starter solution used

3.1 Growth parameters

The treatment significantly altered ~~with~~ all the~~all the~~ growth ~~parameters all the growth~~ parameters at ~~all~~ the successive stages of growth. The ~~treatment T_8 (~~40ml/plant PSB +40ml/Plant Starter solution TA41(diluted)~~)~~ was observed maximum at all successive stage of growth with plant height (cm) (16.89,18.67,30.56), leaf length (cm) (16.47,21.76,28.10), leaf width (cm) (9.68,12.90,16.71), leaf area (m^2) (161.78,305.09,475.35), ~~number of leaves~~leaf number per plant (10.78,12.44,14.89), Days taken to head initiation (49.5). Application of PSB generates higher yield by providing valuable nutrients to the plant and soil and alsoPSB couldplay a pivotalrole ~~in~~making ~~of~~ solublephosphorusavailabletoplants while Starter Solution gives theplants a higher survival rate and earlier renewal rate. PSB and Starter Solution improved the broccoli growth and growth parameter. The performance of the plants was better in treated treatments in comparison to the control. These similar findings were recorded by **(Shima*et al.*, 2016,Munsi*et al.*,2013**and**Sivasakthivelan*et al.*, 2021)**

Comment [S4]: Putalso the interpretation of the data by comparing the best treatment with the control for example in percentages

3.2 Yield parameters

The highest head weight was in the treatment ~~T_8 (~~40ml/plant PSB +40ml/Plant Starter solution TA41(diluted)~~)~~ (440.00g), highest yield per plot (3.22kg) and the maximum yield per hectare (14.6t/ha) followed by ~~T_7(~~40ml/Plant PSB +20ml/Plant Starter Solution TA41 (Diluted)~~)~~. Similarly, **Pathak** and **Ram (2020)**reported that the yield improvement through the application of biofertilizers might be due to available nutrients, particularly N and P and micronutrients, increase microbial activity, and a production of growth-promoting substance, and plant-soil-microbes interaction in broccoli, cabbage, tomato.

Table No. 1 Effect of different levels of PSB and organic starter solution on growth traits of Broccoli (*Brassica oleracea* var. *italic* L.) c v. Lucky

Comment [S5]: Please put lowercase notation after the average number to make it easier to read and interpret, than just the critical difference in all the tables

Notations	Treatment combinations	Plant height			Leaf length		
		25 DAT	50 DAT	75 DAT	25 DAT	50 DAT	75 DAT
T_0	Control	9.00	10.78	14.11	12.92	15.94	18.28

T_1	20ml/Plant PSB(Diluted)	12.67	14.67	27.00	14.27	19.87	23.78
T_2	40ml/plant PSB (diluted)	13.44	15.67	21.56	15.42	18.90	24.43
T_3	20ml/plant starter solution TA41(diluted)	11.44	13.33	24.44	14.01	16.39	23.36
T_4	40ml/plant starter solution TA41(diluted)	11.22	11.83	21.00	13.09	18.97	22.77
T_5	20 ml/pant PSB+ 20ml/Plant Starter SolutionTA41 (diluted)	14.33	15.33	25.33	13.67	18.34	22.31
T_6	20ml/plant PSB+ 40ml/Plant Starter solutionTA41 (diluted)	15.33	16.67	28.11	16.26	19.46	25.69
T_7	40ml/plant PSB+ 20ml/Plant Starter solutionTA41 (diluted)	16.33	18.33	29.67	15.53	19.87	26.79
T_8	40ml/plant PSB +40ml/Plant Starter solution TA41(diluted)	16.89	18.67	30.56	16.47	21.76	28.10
	SE.d(±)	0.34	0.33	0.66	0.22	0.59	0.88
	CD	1.01	0.99	1.98	0.66	1.76	1.86
	CV	4.28	3.88	4.64	2.60	5.40	4.50

Table No. 2 Effect of different levels of PSB and organic starter solution on growth traits of Broccoli (*Brassica oleracea* var. *italic* L.) c v. Lucky

Notations	Treatment combinations	Leaf width			Leaf area		
		25 DAT	50 DAT	75 DAT	25 DAT	50 DAT	75 DAT
T_0	Control	7.26	10.19	11.36	101.00	154.70	207.60
T_1	20ml/Plant PSB(Diluted)	8.74	12.23	13.17	128.19	223.60	313.14
T_2	40ml/plant PSB (diluted)	9.68	13.48	14.06	139.32	221.72	336.52
T_3	20ml/plant starter solution TA41(diluted)	9.09	10.71	12.29	101.37	186.12	272.85
T_4	40ml/plant starter solution TA41(diluted)	8.52	10.30	14.01	121.51	197.55	319.743
T_5	20 ml/pant PSB+ 20ml/Plant Starter SolutionTA41 (diluted)	8.69	10.89	15.53	127.49	213.49	344.79
T_6	20ml/plant PSB+ 40ml/Plant Starter solutionTA41 (diluted)	9.21	12.52	14.32	148.28	234.38	403.39
T_7	40ml/plant PSB+ 20ml/Plant Starter solutionTA41 (diluted)	9.76	12.27	16.58	158.35	265.36	447.69
T_8	40ml/plant PSB +40ml/Plant Starter solution TA41(diluted)	9.68	12.90	16.71	161.78	305.09	475.35

	SE.d(±)	0.25	0.47	0.41	7.29	12.70	15.10
	CD	0.75	1.41	1.23	15.45	26.92	32.00
	CV	4.85	6.94	5.01	6.76	6.99	5.33

Table No. 3 Effect of different levels of PSB and organic starter solution on growth traits of Broccoli (*Brassica oleracea* var. *italic* L.) c v. Lucky

Notations	Treatment combinations	No. of leaves per plant			Days taken for head initiation
		25 DAT	50 DAT	75 DAT	
T_0	Control	8.78	10.11	11.78	55.72
T_1	20ml/Plant PSB(Diluted)	8.89	10.44	11.89	54.8
T_2	40ml/plant PSB (diluted)	10.22	11.22	12.56	54.23
T_3	20ml/plant starter solution TA41(diluted)	9.00	10.22	11.78	53.72
T_4	40ml/plant starter solution TA41(diluted)	9.78	11.00	12.44	53.34
T_5	20 ml/pant PSB+ 20ml/Plant Starter SolutionTA41 (diluted)	8.89	10.44	12.67	52.69
T_6	20ml/plant PSB+ 40ml/Plant Starter solutionTA41 (diluted)	9.67	11.22	12.78	51.3
T_7	40ml/plant PSB+ 20ml/Plant Starter solutionTA41 (diluted)	9.33	11.56	14.22	50.46
T_8	40ml/plant PSB +40ml/Plant Starter solution TA41(diluted)	10.78	12.44	14.89	49.5
	SE.d(±)	0.26	0.25	0.41	0.68
	CD	0.77	0.74	1.24	1.44
	CV	4.69	3.91	5.58	1.58

Table No. 4 Effect of different levels of PSB and organic starter solution on yield traits of Broccoli (*Brassica oleracea* var. *italica* L.) c v. Lucky

Notations	Treatment combination	Head weight(g)	Head weight per plot (kg)	Head yield per tones (t/ha)

T_0	Control	171.56	1.05	5.7
T_1	20ml/Plant PSB(Diluted)	227.11	1.52	7.5
T_2	40ml/plant PSB (diluted)	268.00	1.72	8.9
T_3	20ml/plant starter solution TA41(diluted)	296.42	1.63	9.8
T_4	40ml/plant starter solution TA41(diluted)	267.16	1.63	8.8
T_5	20 ml/pant PSB+ 20ml/Plant Starter SolutionTA41 (diluted)	317.53	2.10	10.5
T_6	20ml/plant PSB+ 40ml/Plant Starter solutionTA41 (diluted)	346.04	2.37	11.5
T_7	40ml/plant PSB+ 20ml/Plant Starter solutionTA41 (diluted)	394.11	2.69	13.1
T_8	40ml/plant PSB +40ml/Plant Starter solution TA41(diluted)	440.00	3.22	14.6
	SE.d(±)	23.71	0.15	0.45
	CD	50.27	0.33	0.96
	CV	9.58	9.47	5.52

4. CONCLUSION

On the basis of present investigation, it is concluded that the ~~treatment T_8 (~~40ml/Plant PSB+40ml/Plant TA41 Starter Solution~~)~~was found best in respect to plant height, leaflength, leaf width, ~~No.of leaves~~leaf number per plant, leaf area, days to head initiation, head weight, headyieldperplot,headyieldperhectare.Thistreatmentalsoshowedmaximumgrossreturn,netreturnand benefit cost ratio(4.96).

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