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PRODUCTIVITY OF BROCCOLI (*Brassica oleracea*) PLANTS TREATED WITH BIO , ORGANIC AND N FERTILIZERS UNDER ALLUVIAL SOIL CONDITIONS

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ABSTRACT

A Field experiment was carried out on broccoli (*Broccoli oleraceae* L. var. *Italica* cv. *Southern Star*), Brassicaceae family, in Faculty of Agriculture, El-Mansoura University, Egypt during 2010 season to study the effect of both farmyard manure and Agrisbone (Commercial fertilizer) as biofertilizer source and N fertilizer rates on vegetative growth, yield and flower spear quality of broccoli plants grown on alluvial soils. Treatments were represented all combination of FYM rates (control and 20 m^3 fad^{-1}) and N fertilizer rates (control, 50,100 and 150 kg fad^{-1} as ammonium sulphate, (20.5 % N) in presence of Agrisbone (with and without addition) in split split plot design with three replicates.

The obtained results could be summarized as follows:

- Statistical analysis revealed that the highest mean values of leaves number, branches number and leaf area of broccoli plants were obtained from 150 kg fad^{-1} mineral treatment jointly with inoculated plants in absence of FYM, while the highest mean values of fresh and dry weight were produced from the inoculated plants with 100 N kg fed^{-1} under FYM treatment. On the other hand, the lowest mean values of aforementioned characteristics obtained from untreated broccoli plants.
- Data indicated that the maximum mean values of height and diameter spear flower produced from plants received FYM and Agrispone combined with 100 N $kgfad^{-1}$ as compared to the other treatments.
- The broccoli plants that fertilized with FYM + Agrispone + 100 N $kgfad^{-1}$ gave the highest increments in the two stages of spear flower broccoli yield; 1^{st} and 2^{nd} cuts. Meanwhile, unfertilized broccoli plants gave the lowest mean values of aforementioned traits in the two stages; 1^{st} and 2^{nd} cuts, respectively.

Keywords: Farmyard manure (FYM), Boifertilizer (Agrispone), N mineral fertilizer rates, Broccoli plants.

INTRODUCTION

In Egypt, chemical fertilizers are used heavily to maintain to the soil fertility and to ensure crop production. Normally, Egyptian growers are used to add huge amounts of mineral fertilizers to obtain the maximum yield from the crop area. Although the modern agriculture production requires efficient, sustainable, and environmentally sound fertilizer management practices. Consequently, the adequate rates, appropriate sources and efficient methods of application are important strategies for maintaining nutrients supply potential of soils (Fageria and Baligar, 2005).

Broccoli, a member of the Brassicaceae family of vegetables, is a rich source of sulphoraphane, which has been shown to display potent anti carcinogenic properties. However, over half of the national population fails to

benefit from this because they lack a specific gene (GSTM1) that helps retain the compound in the body (Kirsh *et al.*, 2007). "Eating a few portions of broccoli each week may help to reduce the risk of cancer. Bladder cancer is diagnosed in about 336,000 people every year worldwide, and it is three times more likely to affect men than women, according to the European School of Oncology. The cancer-fighting properties of broccoli, a member of the crucifer family of vegetables, are not new and previous studies have related these benefits to the high levels of active plant chemicals called glucosinolates (Zhao *et al.*, 2007). (These are metabolized by the body into isothiocynates, and evidence suggests these are powerful anti-carcinogens. Eating more than one serving of broccoli a week may reduce the risk of prostate cancer by up to 45 per cent, says a new study. The tissue of crucifer vegetables, which also include cauliflower, cabbage and brussels sprouts, contain high levels of the active plant chemicals glucosinolates. These are metabolized by the body into isothiocynates, which are known to be powerful anti-carcinogens. The values of content of phenolic substances and total antioxidant activity of the sets of samples correlate very well for all used methods.)

Chaterjee Sigh *et al.*, 2005, demonstrated that bio-fertilization increased yield of broccoli and cruciferous vegetables. Abou Elmagd *et al.*, 2009, studied the effect of nitrogen sources on broccoli plant.

Broccoli is one of the most promising export crops in Egypt. It is also rich in phytochemicals, which offer human protection against certain cancers and heart iseases (Keck, 2004). Further, broccoli is grown in very limited scattered areas and the total cultivated area is not exactly known (Elwan and Abd El-Hamid, 2011). Therefore, this research was done to estimate vegetative growth and flower spear yields of broccoli plants under different sources of farmyard manure and mineral N fertilizer with or without bio-fertilizer under alluvial soil conditions.

MATERIALS AND METHODS

a field experiment was carried out on broccoli *(Broccoli oleraceae L.* var. *Italica)* family Brassicaceae in Faculty of Agriculture, El-Mansoura University , Egypt, during the winter season 2010. To study the effect of some cultural practices such as(FYM), Agrispone and different nitrogen rates on growth, yield and quality of broccoli crop, Soil samples were collected at random before planting from the top layer (0-30 cm depth) for physical and chemical analysis. Soil analysis is presented in Table 1, soil physical properties were analyzed using the procedures described by Hesse (1971) for particle size distribution and soil texture, while soil chemical analysis was measured according to the procedures described by Jackson (1973).

Table 1: The physical and chemical properties of the experimental soil during 2010 season.

Particle size distribution (%)	Value	Property	Value
Sand	24.80	ECe(dSm^{-1})	3.5
Silt	27.00	pH**	7.8
Clay	48.20	Available nutrients (mg kg^{-1}soil)	
Texture	clayloam	N	34.00
OM%	1.42	P	5.6
$CaCO_3$%	1.20	K	288

*Soil paste extract, **(1:2.5,soil:water suspension)

The experimental design was split split plot design. Main plots were assigned to the two of farmyard manures, while the two treatments of Agrispone were occupied in the sub-plots, and the four treatments of nitrogen (N) were representative the sub-sub plots. Hence, the total number of present trial was 2 rates (FYM) x 2 treatments (Agrispone) × 4 rates (N) = 16 treatments. Each treatment was replicated 3 times to give a total number of 48 experimental units. The total treatment area was 7*1.5=10.5m

1. **The first factor (2 treatments):** one rates of farmyard manures(20ton/fad) was applied as well as control(without application farmyardmanure),. Organic farmyard Abou Elmagd *et al.*, 2009 contents of total available N, P and K are presented in Table 2 and its chemical analyses followed the procedure of Hesse (1971).

Table 2: Chemical analysis of used farmyard manure

Total nutrients elements (%)			O.M %	C %	EC dSm^{-1}	C/N ratio	pH
N	P	K					
1.18	0.29	2.0	42.0	14.0	3.52	21:1	7.7

Farmyard manures were incorporated into the soil and then soil was irrigated and left for 2weeks before transplanting

2. **The second factor (2 treatments):** Biofertilizer(Agrispone) was applied at rate **1litre** fad^{-1} as well as control This biofertilizer was obtained from Integrated Control Res. Dept., Plant Pathology Res. Inst., Agric. Res. Center, Agriculture Giza. It was mixed on site just before the inoculation and added to the soil surface beside plants afte six weeks from transplanting.
3. **The third factor (4 treatments):** Nitrogen was applied in the form of ammonium sulphate (20.5% N) at three rates 50,100 and 150 kg N fad^{-1} as well as control treatment.

Mineral fertilizer was added to the soil using ammonium sulfate (20.5 % N) as a source of nitrogen, calcium super phosphate (15.5 % P_2O_5) as a source of phosphorus at a rate of 60 P_2O_5 kg fad^{-1} and potassium sulphate (48 % K_2O) as a source of potassium at a rate of 48 K_2O kg fad^{-1}, as the quantities of the chemical fertilizer were splinted into three equal doses 3, 6 and 9 weeks after transplanting) beside plants. Seedlings(three weeks in

age) were transplanted at fourth March on one side of each row in 75 cm width and 25 cm apart. Each plot included three rows, plot area was 10.5 m^2.

Data recorded: -

I) Vegetative growth characters: A random sample of five plants was taken from each experimental treatment 60 days after transplanting and the following data were recorded during the experimental season.

1) Leaves number/ plant. 2) Branches number/ plant.
3) Total fresh weight (g $plant^{-1}$). 4. Total dry weight (g $plant^{-1}$).
5. Leaf area (cm^2).(uses of planimitr)of fives leaf from top.

II) Flower spear yields and its component: All broccoli flower spear yields of each plot were harvested at maturing in order to record these data.

1) First flower spear yields (g $plant^{-1}$). 2) Second flower spear yields (g $plant^{-1}$).
3) Head diameter (cm). 4) Head height (cm).

III) Statistical analysis: -

Data were statistically analyzed using descriptive statistics and analysis of variance (ANOVA). Based on a two-way ANOVA, the effect of bio-organic and mineral-fertilization treatments as well as their interactions were evaluated according to the procedure outlined by Duncan (1955) using CoStat (Version 6.303, CoHort, USA, 1998–2004). Means of treatments were considered significantly different using the least-significant-differences test (LSD) at the confidence level of 5% according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Vegetative growth characteristics:

As shown in Table 3, vegetative growth of broccoli plants expressed as leaves number/plant, leaf area, fresh and dry weight of plants were affected by bio-organic and N fertilization rates. Data in the same Table reveal that there are significant differences among all investigated vegetative growth parameters with the exception of leaf area (m^2) as affected by organic manure, inoculation and N rates under experimental conditions.

Table 3 indicates that plants that fertilized with FYM gave mean values of vegetative growth more than those unfertilized with FYM. With respect to the effect of bioinoculation, the aforementioned Table reveals that plants which inoculated give markedly results more than non inoculated plants under experimental conditions. Further, Table 3 shows that the vegetative growth parameters of fertilized plants increased with the increasing of N fertilizer as compared to the untreated plants.

As shown in the same Table, the highest mean values of leaves number, branches number and leaf area of plant were 57.33, 8.33, 0.583 m^2,resectviliy obtained from 150 kg N fad^{-1} mineral treatment jointly with inoculated broccoli plants in absence of FYM, while the highest mean values of fresh and dry weight were 698.33 and 96.15 g $plant^{-1}$ produced from the inoculated plants with 100 N kg fad^{-1} under FYM treatment. On the other hand, the lowest mean values of aforementioned characteristics were 27.33, 3.33, 0.393, 249.33 and 42.31g $plant^{-1}$respectivily obtained from untreated

broccoli plants. Similar results were recorded by Abu El-Magd, *et al.*, 2009 and Selim *et al.*, 2009), they reported that bio-fertilization increased growth of broccoli plants Further, Organic fertilizers are one of the natural amendments which applied to increase the rate of organic matter in soil associated with improving in the physical, chemical and biological properties of the soil and consequently improve plant growth (Suganya and Sivasamy, 2006).

Table 3: Effect of bio, organic and N fertilizer rates and their interaction on vegetative growth of broccli plants during 2010 season.

Organic(FYM 20 ton/fad)	Biofertiizers(Agrispon 1 litre/fad)	N-rates Kg/fad-1	No. of		Leaf Area (cm^2)	Weight of plant (g)	
			Leaves	branches		Fresh	Dry
Without	Non-inoculated	Without	27.33	3.33	0.393	249.33	42.31
		50	38.33	4.67	0.483	377.67	53.81
		100	39.33	5.33	0.477	448.67	54.00
		150	55.00	8.33	0.490	528.00	54.14
	Mean		40.00	5.42	0.46	400.92	51.07
	Inoculated	Without	34.67	4.00	0.417	361.33	52.61
		50	41.00	5.33	0.460	422.00	62.05
		100	47.00	7.00	0.470	521.67	60.78
		150	57.33	8.33	0.583	678.33	88.20
	Mean		45.00	6.17	0.483	495.83	65.91
Average			42.50	5.79	0.472	448.38	58.49
With FYM	Non-inoculated	Without	32.33	4.00	0.473	448.67	57.10
		50	43.33	5.00	0.547	643.33	57.36
		100	50.00	7.33	0.540	605.00	57.88
		150	51.33	8.33	0.513	671.33	70.86
	Mean		44.25	6.17	0.518	592.08	60.80
	Inoculated	Without	44.00	6.00	0.413	394.33	62.18
		50	46.00	7.00	0.497	558.00	81.20
		100	51.67	7.00	0.523	698.00	96.15
		150	54.67	8.00	0.527	688.33	83.11
	Mean		49.09	7.00	0.490	584.67	80.66
Average			46.67	6.58	0.504	588.37	70.73
F. Test			*	*	NS	**	*
LSD at 0.05			2.00	0.06	–	23.65	12.00

Head quality:-

As shown in Table 4, this study revealed that FYM, bioinoculants and inorganic fertilizers had a significant impact on spear flower quality i.e.; head height and diameter of broccoli crop at 1st and 2nd cut, respectively.

Table 4:Effect of bio, organic and N fertilizer rates and their interaction on head height and its diameter (cm) of broccli plants during 2010 season.

Organic	Biofertiizers	N- rates fed^{-1})	Flower spear			
			Height (cm)		Diameter (cm)	
			1st cut	2nd cut	1st cut	2nd cut
Without	Non-inoculated	Without	9.34	15.04	7.66	8.25
		50	10.92	15.22	8.47	9.45
		100	11.38	17.06	8.41	10.43
		150	11.44	17.65	8.26	12.54
	Mean		10.77	16.24	8.20	10.17
	Inoculated	Without	10.76	17.11	8.16	13.19
		50	11.49	18.11	9.36	13.02
		100	10.70	17.61	8.40	12.45
		150	10.78	18.32	9.29	13.73
	Mean		10.93	17.79	8.80	13.10
Average			10.85	10.85	17.02	8.50
With FYM	Non-inoculated	Without	11.39	18.51	8.67	12.86
		50	9.83	18.34	8.66	13.38
		100	11.14	17.11	8.94	13.70
		150	10.99	19.66	9.21	12.24
	Mean		10.84	18.41	8.87	13.05
	Inoculated	Without	10.42	17.59	10.47	13.37
		50	12.91	18.19	11.16	15.94
		100	13.24	22.77	11.69	17.34
		150	11.75	18.66	10.95	15.12
	Mean		12.08	19.30	11.07	15.44
Average			11.46	11.46	18.85	9.97
F. Test			*	*	*	**
LSD at 0.05			0.07	0.32	0.03	0.15

Concerning the combined effect, the best mean values of flower spear height were 13.24 and 22.77cm occurred with plants received FYM and inoculants jointly with 1·0 kg fed^{-1} application at 1st and 2nd cut, respectively and spear flower diameter were 11.69 and 17.34 cm obtained from FYM and inoculants jointly with 100 kg fed^{-1} application at 1st and 2nd cuts, respectively. Meanwhile, the lowest mean values of the aforementioned traits were 9.34, 15.04, 7.66 and 8.25 cm obtained from untreated broccoli plants at both 1st and 2nd cuts, respectively. These increases may be attributed to the cumulative effect of nutrient transformation and plant growth promotion. Moreover, application of *Azotobacter chroocccum, Bacillus megaterium* and *Bacillus circulans* giving maximum benefit in terms of broccoli yield and spear quality (Zaki, *et al.*, 2009).

Total yield:

From tabulated results in Table 5, it can be noticed that there were significant differences among the spear flower yield of broccoli plants at first and second flower spears.

Secondary and main spear flower yield of the bio-organic fertilized plants recorded higher values compared with the untreated plants.

Table 5: Effect of bio, organic and N fertilizer treatments and their interaction on spear flower yield (Mg* fed^{-1}) of broccli plants during 2012 season.

Biofertiizers (Ag 1 l/fad)	N-rates (Kg fad^{-1})	Organic(FYM ton/fad)			
		Without		With	
		1st cut	2nd cut	1st cut	2nd cut
Non-inoculated	Without	0.620	0.889	0.690	2.775
	50	0.720	1.198	0.890	2.799
	100	0.750	2.249	0.793	2.842
	150	0.717	2.328	1.040	2.889
Mean		0.700	1.666	0.853	2.826
Inoculated	Without	0.687	2.630	0.91	2.484
	50	0.990	2.757	1.237	2.942
	100	1.143	3.008	1.437	3.812
	150	1.160	3.231	1.220	3.270
Mean		0.995	2.907	1.201	3.127
Average		0.848	2.286	1.027	2.977
F. Test		*	**	*	*
LSD at 0.05		0.08	0.43	0.09	0.15

* Mg Fad^{-1} = Mega Gram Per Faddan = Ton Per Faddan

Data presented in Table 5 indicated that application of mineral fertilizer increased the total yield and its components, i .e. first, second and third of broccoli heads. However, the geatest flower spear yield was recorded by high mineral fertilizer treatment followed by plants low mineral fertilizer treatment came in the second order.

Interaction of organic-bio fertilization with nitrogen fertilizer rates statistically affected on spear yield of broccoli was shown in the same Table. These results held well in the experimental season. Generally, it could be concluded that, the greatest spear flower yields of broccoli plants were 1.437 and 3.812 tonfad^{-1} recorded by the combined effect of bio-organic fertilizer and jointly with 100 kgfad^{-1} N treatment at the two cuts, respectively. On the contrary, the lowest spear flower yields of broccoli plants were 0.690 and 2.75 ton fed produced from untreated broccoli plants at the 1st and 2nd cuts, respectively. This may be attributed to organic matter increment contribute to reduce the leaching out of nutrients through: (a) improving soil structure toward prompting the ability of this soil to retain and conserve irrigation water against rapid loss by leaching and deep percolation and (b) ability of the active groups of organic matter (fulvic, humic acids and humus) to retain the inorganic elements in complex and chelate forms (Das and Nand Ram, 2006) which broken down slowly by soil microorganisms and release the elements over a period of time.

CONCLUSION

It could be concluded that the potential of producing high and good flower spear yields of broccoli plants at a rate 20 m^3 fed^{-1} of farmyard manure

and 100 N kg fed^{-1} jointly with inoculation of agrispone as a biofertilizer. Thus, it these treatments can replace partially instead of N mineral fertilizer, which protect the environment chemical pollution and its harmful effect on human and animal health besides reducing the production costs.

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انتاجية محصول البروكلي تحت تأثير إضافة بعض الأسمدة العضوية والحيوية والنتروجينية تحت ظروف الأراضي الرسوبية

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أجريت تجربة حقلية خلال موسم زراعي (٢٠١٠-٢٠١١) على تربة طميية بمنطقة كلية الزراعة-جامعة المنصورة- محافظة الدقهلية – مصر في الموسم الشتوي بهدف تقليل استخدام الأسمدة الكيماوية النتروجينية ، وذلك عن طريق دراسة تأثيرمخلوط الأسمدة الحيوية (أجريسبون)، وسماد مخلفات المزرعة ، بالاضافة إلى التسميد الكيماوي بمعدلات مختلفة من المعدل الموصى به من السماد النتروجيني (سلفات نشادر)(٥٠، ١٠٠، ١٥٠كجم ن للفدان)بالاضافة لمعاملة المقارنة(بدون اضافة)على: النمو الخضري للنبات، بالإضافة إلى محصول البروكلي وجودته.

ويمكن تلخيص النتائج المتحصل عليها في الآتي:

- أشارت نتائج التحليل الاحصائي إلى أن اكبر عدد لكل من الاوراق والافرع ومساحة الورقةللنبات ككل كانت من نتيجة معاملة التسميد الحيوي مع معاملة التسميد الكيماوي بمعدل ١٥٠كجم ن للفدان من المعدل الموصى به وذلك في عدم وجود التسميد العضوي. بينما كانت أكبر زيادة في الوزن الجاف والطازج للنبات نتيجة لمعاملات التسميد الكيماوي بمعدل ١٠٠ كجم للفدان من المعدل الموصى به في وجود التسميد الحيوي والتسميد العضوي مقارنة بباقي المعاملات.
- اشارت النتائج المتحصل عليها إلي أن أعلي متوسطات لقطر وارتفاع قرص البروكلي (بالسنتمتر) نتيجة التسميد المشترك بسماد مخلفات المزرعة مع التسميد الحيوي مع إضافة ١٠٠ كجم ن للفدان سواء في القرطة المبكرة أو المتأخرة مقارنة بمعاملة المقارنة.
- وجد أن النباتات التي سمدت بمعدل ١٠٠ كجم ن للفدان بالاضافة إلى التسميد الحيوي والعضوي معاً أعطت أعلى محصول لأقراص البروكلي مقارنة بمعاملة المقارنة فقط سواء في القرطةالمبكرة أو المتأخرة على التوالي.

عموماً يمكن التوصية بإمكانية الإستغناء عن التسميد الكيماوي جزئيا ، مما ينتج عنه حماية البيئة من التلوث الكيماوي وأثره الضارعلى صحة الإنسان وهي أهم الأهداف المطلوب تحقيقها في العالم، بالإضافة إلى خفض تكاليف الإنتاج.

قام بتحكيم البحث

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