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Effect of Organic Manures Enriched with Bio–fertilizers on Growth of Onion (*Allium cepa* L.)

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Abstract: *An Investigation was undertaken on onion var. Agrifound Light Red to study the effect of different organics on growth of onion. The experiment was laid out in Randomized Block Design with nine different treatment combinations replicated thrice. Most of the growth parameters were improved significantly with the organic manures over inorganic fertilizers. The maximum plant height (29.32 cm, 47.31cm, 54.31cm and 55.18 cm), leaf length (25.34cm, 43.35cm, 46.83cm and 45.30 cm), number of leaves per plant (5.29, 8.50, 14.39 and 18.27) and leaf dry weight (0.50 g, 1.43 g, 2.92 g and 9.46 g) were recorded with farmyard manure (50%) + vermicompost (25%) + neem cake (25%) + Azospirillum and PSB @ 5 kg ha^{-1} each at 30, 60, 90 and 120 DAT respectively. But, there was no significant difference found among various treatments of organic manures with respect to neck thickness and leaf width.*

Key words: *Bio fertilizer, Growth , Onion, Organic manure*

INTRODUCTION

Onion (*Allium cepa L.*) is one of the most important commercial vegetable crops cultivated extensively in India and used for flavouring or seasoning the food, both at mature and immature stages. In India, onion is being grown in an area of 10.51 lakh hectare with production of 168.13 lakh tonnes and the productivity is 16.0 tonnes. In Andhra Pradesh, onion is cultivated in an area of 86.67 thousand hectares with production of 15.60 lakh tonnes and the average productivity of 18.0 tonnes (NHB, 2013 [12]). With increase in cost of inputs, inorganic fertilizers became increasingly more expensive. Due to continuous and indiscriminate use of inorganic inputs soil health has been severely affected. The occurrence of multi-nutrient deficiencies and overall decline in the productivity of the soil under intensive fertilizer use have been widely reported (Chhonkar, 2003 [4]). Consequently, many farmers are seeking alternative practice of organic farming to make agriculture more sustainable.

Therefore, judicious and proper use of organic manures and fertilizers is very essential not only for obtaining higher growth, yield and quality produce but also to maintain soil health and sustainability in long run. Organic vegetables are gaining importance because of less chemical residues and better taste. Considering the adverse effects on soil, water and environment luxurious usage of inorganic fertilizers should be curtailed down. Since major foreign earning of our country comes from fresh onion and the onion growers in india mostly raise this crop inorganically, the present investigation was taken up to study the effect of different organics on growth of onion.

MATERIAL AND METHODS

The present investigation was conducted during *rabi* season of 2013 at Instructional Farm, College of Horticulture, Dr. Y.S.R. Horticultural University, Rajendranagar, Hyderabad, Andhra Pradesh. The onion variety Agrifound Light Red used as experimental material and the experiment was laid out in Randomized Block Design with three replicated 9 treatments *viz*., T_1: Farmyard manure (50%) + Vermicompost (50%), T_2: Farmyard manure (50%) + Vermicompost (50%) + *Azospirillum* and PSB @ 5 kg ha^{-1} each, T_3:Farmyard manure (50%) + Vermicompost (25%), + Neem cake (25%), T_4:Farmyard manure (50%) + Vermicompost (25%),

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+ Neem cake (25%) + *Azospirillum* and PSB @ 5 kg ha^{-1} each, T_5:Poultry manure (50%) + Vermicompost (50%), T_6:Poultry manure (50%) + Vermicompost (50%) + *Azospirillum* and PSB @ 5 kg ha^{-1} each, T_7: Poultry manure (50%) + Vermicompost (25%) + Neem cake (25%), T_8:Poultry manure (50%) Vermicompost (25%), + Neem cake (25%) + *Azospirillum* and PSB @ 5 kg ha^{-1} each, and T_9: RDF. The data were recorded on growth parameters like plant height (cm), leaf length (cm), number of leaves per plant, leaf dry weight (gm), neck thickness (mm) and leaf width (mm).

RESULTS AND DISCUSSION

Data on various growth parameters of onion crop as influenced by the different organic manures and their combinations are presented in Table 1 to 6.

Plant Height (cm)

The highest plant height was recorded in T_4 (29.32, 47.31, 54.31 and 55.18 cm at 30, 60, 90 and 120 DAT respectively) with farmyard manure (50%) + vermicompost (25%) + neem cake (25%) + *Azospirillum* and PSB @ 5 kg ha^{-1} each followed by T_9 (28.68, 47.23, 54.23 and 55.12 cm at 30, 60, 90 and 120 DAT respectively) with recommended dose of fertilizers which were significantly superior to all other treatments. The lowest plant height was recorded in T_3 (27.07, 46.02, 52.62 and 53.40 cm at 30, 60, 90 and 120 DAT respectively) with farmyard manure (50%) + vermicompost (25%) + neem cake (25%).

Leaf Length (cm)

Similar to the plant height, the highest leaf length was also recorded in T_4 (25.34 cm, 43.35 cm, 46.83 cm and 45.30 cm at 30, 60, 90 and 120 DAT respectively) with farmyard manure (50%) + vermicompost (25%) + neem cake (25%) + *Azospirillum* and PSB @ 5 kg ha^{-1} each followed by T_9 (25.22 cm, 43.14 cm, 46.24 cm and 45.18 cm at 30, 60, 90 and 120 DAT respectively) with recommended dose of fertilizers which were significantly superior to all other treatments. However, the lowest leaf length was recorded in T_7 (23.72, 41.70, 45.03 and 42.93 cm

Table 1
Plant height (cm) of onion at different stages of crop growth as affected by different organic manures and bio–fertilizers

Treatments		*30 DAT*	*60 DAT*	*90 DAT*	*120 DAT*
T_1 : FYM (50%) + Vermicompost (50%)		27.14	46.17	53.01	54.28
T_2 : FYM (50%) + Vermicompost (50%) + BF		27.26	46.47	53.21	54.66
T_3 : FYM (50%) + Vermicompost (25%) + Neem cake (25%)		27.07	46.02	52.62	53.40
T_4 : FYM (50%) + Vermicompost (25%) + Neem cake (25%) + BF	29.32	47.31	54.31	55.18	
T_5 : Poultry manure(50%) + Vermicompost (50%)		27.11	46.12	52.76	53.83
T_6 : Poultry manure(50%) +Vermicompost (50%) + BF		27.62	46.28	53.27	54.43
T_7 : Poultry manure(50%) + Vermicompost (25%)+ Neem cake (25%)	27.53	46.30	53.34	54.31	
T_8 : Poultry manure(50%) + Vermicompost (25%)+ Neem cake (25%) + BF		28.35	47.06	54.10	55.07
T_9 : RDF @ 150:60:60 NPK kg ha^{-1}		28.68	47.23	54.23	55.12
	S Em±	0.009	0.008	0.009	0.01
	CD	0.02	0.02	0.02	0.04

BF = *Azospirillum* and PSB @ 5 kg ha^{-1} each, DAT = Days After Transplanting.

Table 2
Leaf length (cm) of onion at different stages of crop growth as affected by different organic manures and bio–fertilizers

Treatments		*30 DAT*	*60 DAT*	*90 DAT*	*120 DAT*
T_1 : FYM (50%) + Vermicompost (50%)		24.50	42.68	45.32	44.46
T_2 : FYM (50%) + Vermicompost (50%) + BF		24.32	42.36	45.34	43.56
T_3 : FYM (50%) + Vermicompost (25%) + Neem cake (25%)		24.19	42.59	45.39	43.73
T_4 : FYM (50%) + Vermicompost (25%) + Neem cake (25%) + BF	25.34	43.35	46.83	45.30	
T_5 : Poultry manure(50%) + Vermicompost (50%)		24.09	42.29	45.31	43.33
T_6 : Poultry manure(50%) +Vermicompost (50%) + BF		23.89	42.14	45.17	43.24
T_7 : Poultry manure(50%) + Vermicompost (25%)+ Neem cake (25%)	23.72	41.70	45.03	42.93	
T_8 : Poultry manure(50%) + Vermicompost (25%)+ Neem cake (25%) + BF		25.14	43.09	46.12	45.08
T_9 : RDF @ 150:60:60 NPK kg ha^{-1}		25.22	43.14	46.24	45.18
	S Em±	0.003	0.01	0.04	1.54
	CD	0.009	0.05	0.13	4.64

BF = *Azospirillum* and PSB @ 5 kg ha^{-1} each, DAT = Days After Transplanting.

at 30, 60, 90 and 120 DAT respectively) with poultry manure (50%) + vermicompost (25%) + Neem cake (25%).

Number of Leaves Per Plant

Similar to the plant height and the leaf length, the highest number of leaves per plant were also recorded in T_4 (5.29, 8.50, 14.39 and 18.27 at 30, 60, 90 and 120 DAT respectively) with farmyard manure (50%) + vermicompost (25%) + neem cake (25%) + *Azospirillum* and PSB @ 5 kg ha^{-1} each followed by T_9 (5.19, 7.70, 14.26 and 18.15 at 30, 60, 90 and 120 DAT respectively) with recommended dose of fertilizers which were significantly superior to all other treatments. The lowest number of leaves was recorded in T_1 (4.10, 5.60, 13.27 and 17.11 cm at 30, 60, 90 and 120 DAT respectively) with farmyard manure (50%) + vermicompost (50%).

Leaf Dry Weight (g)

Similar to the plant height, leaf length and number of leaves per plant, the highest leaf dry weight was also recorded in T_4 (0.50, 1.43, 2.92 and 9.46 g at 30, 60, 90 and 120 DAT respectively) with farmyard manure (50%) + vermicompost (25%) + neem cake (25%) + *Azospirillum* and PSB @ 5 kg ha^{-1} each followed by T_9 (0.45 g, 1.40 g, 2.33g and 9.28 g at 30, 60, 90 and 120 DAT respectively) with recommended dose of fertilizers which were significantly superior to all other treatments. The lowest leaf dry weight was recorded in T_3 (0.12 g, 0.88 g, 1.75 g and 7.48 g at 30, 60, 90 and 120 DAT respectively) with farmyard manure (50%) + vermicompost (25%) + neem cake (25%).

Neck Thickness (mm)

There was no significant difference found among various treatments of organic manures with respect to neck thickness at different stages of plant growth. However, numerically higher neck thickness was observed with T_9 treatment receiving RDF and lowest neck thickness was obtained in T_2 with farmyard manure (50%) + vermicompost (50%) + *Azospirillum* and PSB @ 5 kg ha^{-1} each.

Table 3
Number of leaves per plant of onion at different stages of crop growth as affected by different organic manures and bio-fertilizers

Treatments		*30 DAT*	*60 DAT*	*90 DAT*	*120 DAT*
T_1 : FYM (50%) + Vermicompost (50%)		4.10	5.60	13.27	17.11
T_2 : FYM (50%) + Vermicompost (50%) + BF		4.33	6.86	13.54	17.44
T_3 : FYM (50%) + Vermicompost (25%) + Neem cake (25%)		4.53	7.14	13.71	17.53
T_4 : FYM (50%) + Vermicompost (25%) + Neem cake (25%) + BF		5.29	8.50	14.39	18.27
T_5 : Poultry manure(50%) + Vermicompost (50%)		4.73	7.60	13.66	17.68
T_6 : Poultry manure(50%) +Vermicompost (50%) + BF		4.53	7.40	13.83	17.82
T_7 : Poultry manure(50%) + Vermicompost (25%)+ Neem cake (25%)		4.26	6.60	13.42	17.35
T_8 : Poultry manure(50%) + Vermicompost (25%)+ Neem cake (25%) + BF		5.03	7.65	14.12	18.04
T_9 : RDF @ 150:60:60 NPK kg ha^{-1}		5.19	7.70	14.26	18.15
	S Em±	0.05	0.26	0.007	0.008
	CD	0.15	0.78	0.02	0.02

BF = *Azospirillum* and PSB @ 5 kg ha^{-1} each, DAT = Days After Transplanting.

Table 4
Leaf dry weight (g) of onion at different stages of crop growth as affected by different organic manures and bio-fertilizers

Treatments		*30 DAT*	*60 DAT*	*90 DAT*	*120 DAT*
T_1 : FYM (50%) + Vermicompost (50%)		0.13	0.89	1.83	7.51
T_2 : FYM (50%) + Vermicompost (50%) + BF		0.24	0.91	1.98	8.25
T_3 : FYM (50%) + Vermicompost (25%) + Neem cake (25%)		0.12	0.88	1.75	7.48
T_4 : FYM (50%) + Vermicompost (25%) + Neem cake (25%) + BF		0.50	1.43	2.92	9.46
T_5 : Poultry manure(50%) + Vermicompost (50%)		0.36	1.18	2.25	8.61
T_6 : Poultry manure(50%) +Vermicompost (50%) + BF		0.29	1.12	2.20	8.38
T_7 : Poultry manure(50%) + Vermicompost (25%)+ Neem cake (25%)		0.35	0.96	2.23	8.30
T_8 : Poultry manure(50%) + Vermicompost (25%)+ Neem cake (25%) + BF		0.40	1.39	2.30	9.12
T_9 : RDF @ 150:60:60 NPK kg ha^{-1}		0.45	1.40	2.33	9.28
	S Em±	0.01	0.004	0.19	0.01
	CD	0.03	0.01	0.58	0.0

BF = *Azospirillum* and PSB @ 5 kg ha^{-1} each, DAT = Days After Transplanting.

Table 5
Neck thickness (mm) of onion at different stages of crop growth as affected by different organic manures and bio–fertilizers

Treatments		*30 DAT*	*60 DAT*	*90 DAT*	*120 DAT*
T_1 : FYM (50%) + Vermicompost (50%)		5.00	12.61	16.85	15.93
T_2 : FYM (50%) + Vermicompost (50%) + BF		4.79	12.07	16.43	15.31
T_3 : FYM (50%) + Vermicompost (25%) + Neem cake (25%)		5.26	13.02	18.91	17.41
T_4 : FYM (50%) + Vermicompost (25%) + Neem cake (25%) + BF		6.20	13.63	19.67	18.64
T_5 : Poultry manure(50%) + Vermicompost (50%)		4.84	12.52	16.47	15.83
T_6 : Poultry manure(50%) +Vermicompost (50%) + BF		5.63	13.46	18.97	17.04
T_7 : Poultry manure(50%) + Vermicompost (25%)+ Neem cake (25%)		5.66	12.88	18.96	16.33
T_8 : Poultry manure(50%) + Vermicompost (25%)+ Neem cake (25%) + BF		5.78	13.49	19.00	18.50
T_9 : RDF @ 150:60:60 NPK kg ha^{-1}		6.36	14.93	20.00	18.79
	S Em±	0.62	0.78	1.50	1.49
	CD	N.S.	N.S.	N.S.	N.S.

BF= *Azospirillum* and PSB @ 5 kg ha^{-1} each, DAT= Days After Transplanting.

Table 6
Leaf width (cm) of onion at different stages of crop growth as affected by different organic manures and bio–fertilizers

Treatments		*30 DAT*	*60 DAT*	*90 DAT*	*120 DAT*
T_1 : FYM (50%) + Vermicompost (50%)		0.41	0.85	0.89	0.97
T_2 : FYM (50%) + Vermicompost (50%) + BF		0.48	0.87	0.91	1.02
T_3 : FYM (50%) + Vermicompost (25%) + Neem cake (25%)		0.42	0.83	0.92	1.02
T_4 : FYM (50%) + Vermicompost (25%) + Neem cake (25%) + BF		0.52	0.92	1.04	1.18
T_5 : Poultry manure(50%) + Vermicompost (50%)		0.40	0.87	0.88	0.91
T_6 : Poultry manure(50%) +Vermicompost (50%) + BF		0.45	0.84	1.00	1.09
T_7 : Poultry manure(50%) + Vermicompost (25%)+ Neem cake (25%)		0.46	0.89	0.96	1.03
T_8 : Poultry manure(50%) + Vermicompost (25%)+ Neem cake (25%) + BF		0.51	0.91	1.01	1.07
T_9 : RDF @ 150:60:60 NPK kg ha^{-1}		0.56	0.93	1.05	1.19
	S Em±	0.04	0.02	0.06	0.07
	CD	N.S.	N.S.	N.S.	N.S.

BF= *Azospirillum* and PSB @ 5 kg ha^{-1} each, DAT= Days After Transplanting.

Leaf Width (cm)

Similar to neck thickness, there was no significant difference found among various treatments of organic manures with respect to leaf width at different stages of plant growth. However, numerically higher leaf width was observed with T_9 treatment receiving RDF and lowest at T_5 with poultry manure (50%) + vermicompost (50%).

The morphological features like plant height, leaf length, number of leaves and leaf dry weight were greatly influenced by organic sources.

The increased plant height with the application of farmyard manure, vermicompost and neem cake may be attributed to their higher N content of 1.20, 0.95 and 0.84 % respectively. Vasanthakumar (2003 [17]) reported that combined inoculation of *Azospirillum* and PSB produced synergistic effect, resulting in increased shoot length, number of leaves in solanaceous crop plants.

Similar results of increased plant height with FYM were reported in maize (Kumpawat, 2004 [8] ; Balyan *et al*., 2006 [1]), with vermicompost in onion (Reddy and Reddy, 2005 [15]), spinach (Peyvast *et al*. 2008a [13]), mulberry (Ranuma *et al*. 2012 [14]), pepper (Lopez *et al*. 2012 [9]), brinjal (Mamta and Rao, 2012 [10]) and anise (Darzi *et al*., 2012 [6]), with FYM, vermicompost and neem cake in *Solanum nigrum* (Umesha *et al*., 2011 [16]), with vermicompost and neem cake in baby corn (Murugan, 2000 [11]), with neem cake and bio–fertilizers in blackgram (Hakeem *et al*., 2008 [7]) and with poultry manure, neem cake and panchakavya in moringa (Beaulah, 2001 [2]). Similar to plant height, Reddy and Reddy (2005 [15]) further recorded significant increase in number of leaves $plant^{-1}$ with increasing levels of vermicompost (from 10 to 30 t ha^{-1}) in onion (cv. N–53).

The leaf dry weight increased with the age of the crop registering the highest at harvest with the application of different combinations of organic manures. The increase in leaf dry weight may be due to progressive increase in plant height, number of leaves $plant^{-1}$ and leaf length. The FYM can substitute inorganic fertilizers to maintain productivity and environmental quality (Choudhary *et al.* 2002 in chilli [5] ; Bhuma, 2001 [3]).

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