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Effect of Different Combinations of Organics on Nutrient Uptake and Microbial Count in 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 nutrient uptake of onion bulb and microbial count in the soil. The experiment was laid out in randomized block design with 9 treatments replicated thrice. Nutrient uptake and microbial count improved significantly with the organic manures over inorganic fertilizers. The highest nitrogen (44.41 kg ha^{-1}), phosphorus (9.44 kg ha^{-1}), potassium (56.78 kg ha^{-1}) and sulphur (8.69 kg ha^{-1}) uptake were recorded with farmyard manure (50%) + vermicompost (25%) + neem cake (25%) +* Azospirillum *and PSB @ 5 kg ha^{-1} each. But, the highest dry matter (1,955 kg ha^{-1}) was recorded with RDF. The highest bacterial (42.52 CFU X 10^{6} g soil^{-1}), fungi (26.22 CFU X 10^{3} g soil^{-1}) and actinomycetes (21.30 CFU X 10^{4} g soil^{-1}) count were recorded with poultry manure (50%) + vermicompost (50%) +* Azospirillum *and PSB @ 5 kg ha^{-1} each.*

Key words : *Azospirillum, Farmyard manure, Microbial count, Onion*

INTRODUCTION

Onion (*Allium cepa L.*) is one of the most important commercial vegetable crops cultivated extensively in India and is being used in several ways as fresh, frozen and dehydrated bulbs. Dehydrated onion is in great demand which reduces transport cost and storage losses. In India, onion is 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 is 18.0 tonnes ha^{-1} (NHB, 2013 [10]). Organic farming system in India is not new and is being followed from ancient times. It is a method of farming system which primarily aimed at cultivating the land and raising crops in such a way, as to keep the soil alive and in good health by use of organic wastes (crop, animal, farm wastes and aquatic wastes) and other biological materials along with beneficial microbes (biofertilizers) to release nutrients to crops for increased sustainable production in an eco–friendly, pollution free environment.

The plants absorb all the nutrients in the ionic forms irrespective of the sources through, which they are supplied. The nutrients from the organic and inorganic sources differ only in their relative availability for crop uptake. The nutrients release by organic manures are gradual, slow and would become available for crop uptake for longer duration due to its slow decomposition rate.

It is true that the quality of the agricultural produces, particularly of vegetables, fruits etc. improve when the nutrients are supplied through organic manures than when supplied through fertilizers. This is because of the supply of enzymes, hormones and growth regulators from the organic source.In India, very little work has been reported regarding the effect of different organics on nutrient uptake and microbial count in the soil of vegetable crops and in onion particular. Hence the present investigation was taken up to study the effect of different organics on nutrient uptake of onion bulb and microbial count in the soil.

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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 replicated thrice with nine treatment combinations *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%), + 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 parameters like N, P, K and S (kg ha^{-1}) uptake by the onion bulb and microbial count (CFU g soil^{-1}).

RESULTS AND DISCUSSION

Data on nutrient uptake of onion bulb and microbial count in the soil as influenced by the different organic manures and their combinations are presented in Table 1 and 2.

Nitrogen Uptake (kg ha^{-1})

The highest nitrogen uptake (44.41 kg ha^{-1}) was recorded in T_4 with farmyard manure (50%) + vermicompost (25%) + neem cake (25%) + *Azospirillum* and PSB @ 5 kg ha^{-1} each followed by T_9 (43.80 kg ha^{-1}) with RDF which were significantly superior to all other treatments. The lowest was recorded in T_5 (20.91 kg ha^{-1}) with poultry manure (50%) + vermicompost (50%).

The increased N uptake could be due to increased and prolonged availability of N to the plants in these treatments and also due to increased dry matter yield. Nutrient uptake is a positive function of dry matter yield (Ramakal *et al*., 1988 [14]). This is in consonance with the findings of Chalapathi *et al*. (1997 [2]) in stevia and Mallangouda *et al*. (1995 [6]) in onion and garlic.

Phosphorus Uptake (kg ha^{-1})

Similar to the nitrogen uptake the highest phosphorus uptake (9.44 kg ha^{-1}) was also recorded in T_4 with farmyard manure (50%) + vermicompost (25%) + neem cake (25%) + *Azospirillum* and PSB @ 5 kg ha^{-1} each followed by T_9 (8.51 kg ha^{-1}) with RDF which were significantly superior to all other treatments. The lowest was also recorded in T_5 (5.63 kg ha^{-1}) with poultry manure (50%) + vermicompost (50%).

Normally phosphorus is said to be in fixed form and its absorption is a slow process or sometimes not available. Interestingly, in the present study plant supplied with the organic manures have recorded larger uptake of phosphorus. This could be attributed to their chelating action in making ions available and maintaining soil physical condition. It could also be due to the increased availability of P due to the solubility effect of organic acids which were produced from the decomposing organic manures.

Table 1
N, P, K and S uptake (kg ha^{-1}) by onion bulb as affected by different organic manures and bio–fertilizers

Treatments		*N* (kg ha^{-1})	*P* (kg ha^{-1})	*K* (kg ha^{-1})	*S* (kg ha^{-1})	*Dry matter* (kg ha^{-1})
T_1 : FYM (50%) + Vermicompost (50%)		32.15	7.10	39.20	6.31	1,538
T_2 : FYM (50%) + Vermicompost (50%) + BF		31.99	7.56	46.07	7.73	1,757
T_3 : FYM (50%) + Vermicompost (25%) + Neem cake (25%)		34.54	6.82	40.60	6.50	1,624
T_4: FYM (50%) + Vermicompost (25%) + Neem cake (25%) + BF		44.41	9.44	56.78	8.69	1,748
T_5 : Poultry manure(50%) + Vermicompost (50%)		20.91	5.63	33.01	5.07	1,407
T_6 : Poultry manure(50%) +Vermicompost (50%) + BF		22.74	6.31	38.46	6.15	1,577
T_7 : Poultry manure(50%) + Vermicompost (25%) + Neem cake (25%)		31.09	8.00	47.84	7.82	1,817
T_8: Poultry manure(50%) + Vermicompost (25%) + Neem cake + BF (25%) + BF		38.34	8.21	54.69	8.57	1,810
T_9 : RDF @ 150:60:60 NPK kg ha^{-1}		43.80	8.51	54.91	8.61	1,955
	S Em±	0.01	0.001	0.01	0.002	0.36
	CD	0.04	0.002	0.04	0.006	1.10

BF = *Azospirillum* and PSB @ 5 kg ha^{-1} each.

Further FYM and vermi compost might also have reduced the fixation of P and increased the availability of P in soil solution for its better absorption resulting in increased uptake of P in onion.

The P–solubilizing bacteria increased the phosphate availability in soils, which, in turn, helped better proliferation of root growth and uptake of nutrients to the greater extent. These results are supported by the reports of Amburani and Manivannan (2002 [1]) in brinjal and Wange and Kale (2004 [17]) in brinjal.

Potassium Uptake (kg ha^{-1})

The highest potassium uptake (56.78 kg ha^{-1}) was also recorded in T_4 with farmyard manure (50%) + vermicompost (25%) + neem cake (25%) + *Azospirillum* and PSB @ 5 kg ha^{-1} each followed by T_9 (54.91 kg ha^{-1}) with RDF which were significantly superior to all other treatments. The lowest was also recorded in T_5 (33.01 kg ha^{-1}) with poultry manure (50%) + vermicompost (50%).

Nitrogen possibly might have influenced the potassium uptake by virtue of its complementary action with potassium. The increase in K uptake was due to the increased availability of nutrients from the native, as well as from the mineralized organic manures which might have increased the concentration of K in soil solution making it readily available for absorption. Similar trend was recorded in onion by Geeta (1994 [4]). Potash likely to be maintained in exchangeable form in soil treated with organic manures, which in turn might have restricted the K^+ ions getting fixed by inorganic clay particles in soil.

The increased uptake of NPK due to addition of organic manure is due to the action of organic acids which form organic matter complex. Some of which in addition to influencing pH, form stable complexes or chelated compounds with cations responsible for phosphate fixation (Prabhu *et al.*, 2002 [13]). The application of FYM, vermicompost and neem cake, in combination with bio–fertilizers significantly increased yield, improved the chemical properties of the soil, increased the nutrient availability and thereby lead to increased nutrient uptake by onion.

Sulphur Uptake (kg ha^{-1})

The highest sulphur uptake (8.69 kg ha^{-1}) was recorded in T_4 with farmyard manure (50%) + vermicompost (25%) + neem cake (25%) + *Azospirillum* and PSB @ 5 kg ha^{-1} each followed by T_9 (8.61 kg ha^{-1}) with RDF which were significantly superior to all other treatments. The lowest was also recorded in T_5(5.07 kg ha^{-1}) with poultry manure (50%) + vermicompost (50%).

Dry Matter (kg ha^{-1})

The highest dry matter (1,955 kg ha^{-1}) was recorded in T_9 with RDF followed by T_7 (1,817 kg ha^{-1}) with poultry manure (50%) + vermicompost (25%) + Neem cake (25%) which were significantly superior to all other treatments. The lowest was recorded in T_5 (1,407 kg ha^{-1}) with poultry manure (50%) + vermicompost (50%).

The uptake of NPK was increased significantly with the application of vermicompost in pearl millet (Narolia *et al.*, 2009 [9]), brinjal (Nihad and Jessykutty, 2010 [11]), pomegranate (Marathe *et al.*, 2010 [7]) and fenugreek (Deora and Jitendra Singh, 2008 [3]), with neem cake in okra (Ojeniyi and Sanni, 2000 [12]) and wheat (Sushanta *et al.*, 2012 [16]) and with bio–fertilizers in cauliflower (Narayanamma *et al.*, 2005 [8]).

Table 2
Microbial count (CFU g soil^{-1}) in the soil as affected by different organic manures and bio–fertilizers

Treatments	*Bacteria (CFU × 10^6 g soil^{-1})*	*Fungi (CFU × 10^3 g soil^{-1})*	*Actinomycetes (CFU × 10^4 g soil^{-1})*
T_1 : FYM (50%) + Vermicompost (50%)	33.49	21.57	18.13
T_2 : FYM (50%) + Vermicompost (50%) + BF	36.55	23.16	17.58
T_3 : FYM (50%) + Vermicompost (25%) + Neem cake (25%)	34.53	25.51	16.59
T_4 : FYM (50%) + Vermicompost (25%) + Neem cake (25%) + BF	37.72	23.23	15.45
T_5 : Poultry manure(50%) + Vermicompost (50%)	34.53	23.95	16.20
T_6 : Poultry manure(50%) +Vermicompost (50%) + BF	42.52	26.22	21.30
T_7 : Poultry manure(50%) + Vermicompost (25%)+ Neem cake (25%)	36.54	23.86	16.18
T_8 : Poultry manure(50%)+Vermicompost (25%)+ Neem cake (25%) + BF	41.50	25.91	20.93
T_9 : RDF @ 150:60:60 NPK kg ha^{-1}	30.93	20.46	14.50
S Em±	1.53	0.55	0.69
CD	4.63	1.66	2.09

BF= *Azospirillum* and PSB @ 5 kg ha^{-1} each.

Bacteria (CFU × 10^6 g $soil^{-1}$)

The highest bacterial count (42.52 CFU × 10^6 g $soil^{-1}$) was recorded in T_6 with poultry manure (50%) + vermicompost (50%) + *Azospirillum* and PSB @ 5 kg ha^{-1} each followed by T_8 (41.50 CFU × 10^6 g $soil^{-1}$) with poultry manure (50%) + vermicompost (25%) + Neem cake (25%) + *Azospirillum* and PSB @ 5 kg ha^{-1} each which were at par but significantly superior to all other treatments. The lowest bacterial count (30.93 CFU X 10^6 g $soil^{-1}$) was recorded in RDF.

Fungi (CFU × 10^3 g $soil^{-1}$)

Similar to the bacteria, the highest fungi count (26.22 CFU × 10^3 g $soil^{-1}$) was also recorded in T_6 with poultry manure (50%) + vermicompost (50%) + *Azospirillum* and PSB @ 5 kg ha^{-1} each followed by T_8 (25.91 CFU X 10^3 g $soil^{-1}$) with poultry manure (50%) + vermicompost (25%) + Neem cake (25%) + *Azospirillum* and PSB @ 5 kg ha^{-1} each which were at par but significantly superior to all other treatments. The lowest fungi count (20.46 CFU × 10^3 g $soil^{-1}$) was also recorded in RDF.

Actinomycetes (CFU × 10^4 g $soil^{-1}$)

Similar to the bacteria, fungi the highest actinomycetes count (21.30 CFU × 10^4 g $soil^{-1}$) was also recorded in T_6 with poultry manure (50%) + vermicompost (50%) + *Azospirillum* and PSB @ 5 kg ha^{-1} each followed by T_8 (20.93 CFU × 10^4 g $soil^{-1}$) with poultry manure (50%) + vermicompost (25%) + Neem cake (25%) + *Azospirillum* and PSB @ 5 kg ha^{-1} each which were at par but significantly superior to all other treatments. The lowest actinomycetes count (14.50 CFU × 10^4 g $soil^{-1}$) was also recorded in RDF.

Nihad and Jessykutty (2010 [12]) reported that the nitrogen content from the recommended FYM was substituted through vermicompost and green manure (50% each) + RDF (125:100:50 kg ha^{-1}) recorded the highest microbial density of the soil (40.50 CFU g^{-1} bacterial, 31.00 CFU g^{-1} fungi and 27.00 CFU g^{-1}actinomycetes) of brinjal plants.

The favourable effect of organics on soi=l biological properties is a proven fact which helped in providing ideal conditions and presumably increased the microbial activity because of the available high organic matter. Hati et al. (2001 [5]) and Shanmei et al. (2002 [15]) also reported favourable effect of organic manures on soil physical and biological properties.

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