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EFFICACY OF DIFFERENT SOURCES OF NUTRIENTS AND BIOFERTILIZERS ON GROWTH YIELD QUALITY OF ONION

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ABSTRACT

A field experiment was conducted at Horticultural research farm of Babasaheb Bhimrao Ambedkar University, lucknow during the winter season 2013-14 to study the effect of sixteen combinations of bio-fertilizers, organic manures and chemical fertilizers on onion var. NHRDF-Red 2. A gradual shift from using purely organic sources to introducing some proportion of inorganic fertilization is gaining acceptance. It was revealed from the data that application of 50% recommended dose of NPK along with 50% recommended dose of the vermicompost results in maximum vegetative growth (Plant height, Number of leaves, Neck thickness) and bulb growth (Bulb weight, Bulb length, Bulb diameter and bulb size) which is at par with (50% recommended NPK + 50 % FYM), recommended dose of NPK. Similarly, maximum yield per hectare were found in (50% recommended NPK + 50% vermicompost) while minimum yield was observed in control. Maximum quality bulbs (TSS, vitamin C, Reducing Sugars, non-reducing Sugars and Total Sugars) were also found in 100% vermicompost followed by 100% FYM. It is therefore, concluded that (50% recommended NPK + 50% vermicompost) combination is the best for onion cultivation.

Key Words: Inorganic, Organic, Bio-fertilizers, Vermicompost, Pressmud and FYM.

INTRODUCTION

Onion (*Allium cepa* L.) is one of the oldest cultivated species in use for more than 5000 years as a main component of various culinary preparations (Jones, 1983). For a long time, it has been a major part of total horticultural crops exported to Gulf countries and earns foreign exchange. But, still its production is less in respect to our domestic demand and potential

productivity of soil. It is known to benefit in the prevention and treatment of atherosclerosis and coronary heart disease. They can inhibit the aggregation of human blood platelets for arterial blocking. Studies showed that eating moderate amounts (<200 g of onion/week) results in less tendency to form blood clots and lower levels of cholesterol and lipoproteins associated with heart disease in their blood serum than in abstainers (non eaters). The antifungal properties of onion is due to presence of catechol a phenolic compound and it is used to cure earache, swelling and bite of insect and many other diseases like jaundice. Conventional methods of fertilization (inorganic fertiliser) have undoubtedly helped in improving bulb yield. But it degrades the quality and shelf life and in India appears to be incapable of maintaining yields over the long-term. Shifting from using purely inorganic sources to introducing some proportion of organic fertilization is gaining acceptance today. The area under onion cultivation is continuously increasing to match the internal as well as external demand. So, it is obvious that increasing demand requires more production and in turn it requires more inorganic fertilizer application. Excess use of chemical fertilizers resulted in harmful and long term impact on the soil health and sustainability in yield of crop. As nutrients are the major contributing factors their appropriate management practices is essential to achieve the optimum yield of onion. The under and above fertilization of integrated nutrient management may lead to poor growth and yield in terms of quality and quantity of onion. Otherwise, organic farming systems, the use of organic production systems; positive management of biological and ecological systems replaces inputs of synthetic fertilizers and soluble NPK mineral fertilizers. While crop selection must, inevitably, be market driven to provide efficient economic production, a well balanced sequence of crops should be chosen that requires minimum external inputs, nutrients, machinery and energy to maintain soil fertility, and quality and yield of production.

MATERIALS AND METHODS

A field experiment was conducted to study the effect of chemical fertilizers, organic fertilizers and bio-fertilizer on yield and quality of onion cv. NHRDF Red 2 at the Horticulture Research Farm of Babasaheb Bhimrao Ambedkar University, Lucknow, India, during 2013-14. The experiment was laid out in RBD design with three replications having sixteen treatments consists of four levels of NPK (control, 100% of recommended dose of NPK, 75% of recommended NPK and 50% of recommended NPK), four organic fertilizers; Farm Yard Manure (FYM), Poultry Manure (PoM), Vermicompost (VC) and Pressmud (PM) each at two levels (100% FYM, 50% FYM, 100% PoM, 50% PoM, 100% VC, 50% VC, 100% PM and 50% PM) and three bio-fertilizers; Azotobactor (Azo), Azospirillum (Azr) and

Phosphate Solubilising Bacteria (PSB). There are fifteen treatment combinations and control (T_0- Control, T_1- 100% RDF, T_2- 100% FYM, T_3- 100% PoM, T_4- 100% VC, T_5-100% PM, T_6- 50 % RDF +50% FYM, T_7- 50 % RDF +50% PoM, T_8- 50 % RDF +50% VC, T_9- 50 % RDF +50% PM, T_{10}- 50 % RDF +Azo, T_{11}- 50 % RDF +Azr, T_{12}- 50 % RDF +PSB, T_{13}- 75 % RDF +Azo, T_{14}- 75 % RDF +Azr and T_{15}- 75 % RDF +PSB). The amount of farmyard manure was supplied well before at transplanting time. The recommended doses of fertilizer have applied in the form of urea, SSP and muriate of potash. Urea was applied in two splits (half as basal and half 30 DAT), full doses of phosphorus and potassium were applied as basal at transplanting time. The seedlings of same age (8-week old) were transplanted after seedling dip treatment with bio-fertilizers at the spacing of 15x10 cm. Recommended dose of fertilizer NPK (150:60:60) in the form of Urea, Single Super Phosphate and Muriate of Potash were applied to grow the crop. Data were recorded after harvesting on Plant height (cm), Number of leaves, Neck thickness (cm), Bulb weight (g), Bulb length (cm), Bulb diameter (cm), Bulb size (cm^2), Yield per plot (kg), Yield per hectare (t/ha), Total Soluble Solids (^{0}Brix), Ascorbic Acid (mg/100g), Pyruvic acid (µm/g), Total Sugars (%), Reducing Sugar (%) and Non- reducing sugar (%). TSS was analyzed by Hand Refractrometer, Indolphenol method was used for the determination of ascorbic acid while pyruvic acid analysis was performed as per standard method of Shwimmer & Weston and Total, Reducing and non-reducing sugars were analyzed by Lane and Eynon method**.**

RESULTS AND DISCUSSION

Data presented in Table 1showed that different combinations of inorganic, organic and bio-fertilizer have significant and beneficial effect on vegetative yield and biochemical traits of onion. Data indicated that maximum plant height (57.98 cm), number of leaves (11.23), neck thickness (2.53 cm), bulb weight (116.78 g), bulb length (6.78 cm), bulb diameter (7.30 cm), bulb size (49.58 cm^2), yield per plot (5.89 kg) and yield per hectare (39.61 t/ha) were found in T_8- 50% recommended dose of NPK + 50% VC followed by T_6- 50% recommended dose of NPK + 50% FYM having plant height (55.92 cm), number of leaves (10.76), neck thickness (2.48 cm), bulb weight (110.77 g), bulb length (6.57 cm), bulb diameter (7.22 cm), bulb size (46.85 cm^2), and T_1 recommended dose of NPK for yield per plot (5.86 kg) and yield per hectare (39.92 t). T_6 was at par with T_1- recommended dose of NPK for plant height (54.73 cm), number of leaves (10.13) and bulb weight (107.66 g) were observed and T_9- 50% recommended dose of NPK + 50% PM for neck thickness (2.44 cm), bulb length (6.31 cm), bulb diameter (7.01cm), bulb size (43.46 cm^2). Application of 50% of recommended NPK

and 50% of other organic manure was found more effective and productive as compared to full dose of organic fertilizers and full dose of recommended one. Minimum values for these parameters were observed in control. Similarly, data present in Table 2 exhibit a beneficial response to biochemical parameters that were significantly influenced by all the treatments. Maximum value for ascorbic acid (13.35 mg/100g) was found in T_8 - 50% recommended dose of NPK + 50% VC which is at par with T_6- 50% recommended dose of NPK + 50% FYM while highest content of reducing sugar (5.59 %), non-reducing sugar (7.24 %), total sugar (12.58 %) and TSS (15.82 ^{0}Brix) were found in T_4- 100% VC which was followed by T_8- 50% recommended dose of NPK + 50% VC for reducing sugar (5.37 %), non-reducing sugar (7.16 %), total sugar (12.48 %) and T_2- 100% FYM for TSS (15.70 ^{0}Brix). Minimum value for pyruvic acid (3.48 µm/g) was found in T_4- 100% VC followed by T_2- 100% FYM.

The result revealed that vermicompost is an efficient source able to produce, in combination with inorganic fertilizers, by itself, plant growth and bulb yield that were equivalent to those under RDF. The highest growth and yield response were achieved with 50% RDF+50% VC. This positive performance of the reduced rate of inorganic fertilization with vermicompost might be due to vermicompost worked as supplements to inorganic fertilizers. Mineralization of vermicompost aids in soil nutrient build up that in turn leads to improved nutrient availability to growing crop (Singh *et al.,* 2001). Vermicompost has been reported to contain several plant growth hormones, enzymes, beneficial bacteria and mycorrhizae (Gupta, 2005). As the crop grown under irrigated condition, the beneficial effect of organic manure with inorganic fertilizer results in greater and longer availability of nutrients as per demand of the crop. Highest plant height with the application of vermicompost was also reported by (Reddy and Reddy, 2005). The average bulb weight is known to be influenced by bulb length and bulb diameter which in turn affect yield. These findings are in confirmation with the findings of (Chaddha *et al.,* 2006; Chattoo *et al.,* 2011; Kumar *et al*, 2014) who found significant effect of integrated nutrient management on bulb length and diameter. But the result found by (Bagali, *et al.,* 2012) that the interaction effects between inorganics and organics were found non-significant for bulb yield while higher level or organics and inorganic recorded higher bulb yield individually. Our result is different might be due poor soil condition and high pH 7.2 because at high pH most of the nutrient are present in unavailable form. The poor performance of bio-fertilizers with inorganic fertilizers in comparison to inorganic and organic manure combination might be due to 50% of inorganic fertilizers cannot be supplemented only through bio-fertiliser.

It was observed from the data that biochemical traits are much higher in 100% organically fertilised soil rather than combined application of organic and inorganic fertilizers. 100% application vermicompost results in higher content of TSS, reducing, non-reducing and total sugars and minimum content of pyruvic acid. This might be due to balanced C/N ratio because excess nitrogen content degrades the quality due to more accumulation of nitrate. Highest level of vitamin C by application of 50% RDF with 50% VC might be due to organically produced soils generally produce plants with lower content of nitrogen as compared to chemically fertilised soil as a result crop has more vitamin C less nitrate (Kumar *et al.,* 2014). These findings are also in close agreement with the (Sharath Pal *et al.*, 2014).

CONCLUSION

In conclusion, supplying adequate nutrients to produce onion can be done in an organic system. The treatment combination 50% RDF + 50% Vermicompost is found better as substitute to 100% fertilization with chemical fertilizers for highest yield whereas 100% fertilisation with Vermicompost produce good quality bulb but with less yield. More important thing is that organic fertilizers are cheaper and affordable and also can be produced and in turn it reduces the cost of chemical fertilizers. The increase in the uptake of nutrients by onion with application of NPK along with FYM is obvious as it is considered as a storehouse of plant nutrients, which provide optimum nutrients for crop. So, a farmer can produce good quality bulb along with high yield or somewhat less according to the demand of market without degrading the soil property and health.

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Table 1. Effect of inorganic, organic and bio-fertilizers on growth and yield of onion.

Parameters / Treatments	Plant height (cm)	No. of Leaves	Neck thickness (cm)	Bulb weight (g)	Bulb length (cm)	Bulb diameter (cm)	Bulb Size (cm^2)	Yield per plot (kg)	Yield per hectare (tones)
Control	42.47	8.53	2.17	64.90	4.59	5.51	26.15	4.59	31.11
RDF	54.73	10.13	2.41	107.66	6.20	6.95	42.75	5.86	39.92
FYM	51.68	9.70	2.27	76.55	5.49	6.25	34.12	5.17	34.82
PoM	50.11	9.43	2.21	72.58	5.21	6.13	32.15	4.97	33.88
VC	52.29	9.93	2.31	83.78	6.04	6.82	41.06	5.27	35.06
PM	50.43	9.56	2.27	80.78	5.05	6.11	30.17	5.11	34.42
50 % RDF +50% FYM	55.92	10.76	2.48	110.77	6.57	7.22	46.85	5.82	38.89
50 % RDF +50% PoM	52.43	10.08	2.38	95.23	6.12	6.96	42.59	5.65	37.96
50 % RDF +50% VC	57.98	11.23	2.53	116.78	6.78	7.30	49.58	5.89	39.61
50 % RDF +50% PM	53.41	10.50	2.44	106.96	6.31	7.01	43.46	5.75	38.51
50 % RDF +Azo	51.97	9.46	2.26	84.93	5.41	6.22	33.35	5.47	36.87
50 % RDF +Azr	51.08	9.23	2.28	81.55	5.33	6.07	32.91	5.41	36.15
50 % RDF +PSB	50.07	9.13	2.23	79.38	5.15	5.97	30.93	5.32	35.52
75 % RDF +Azo	53.83	9.96	2.39	96.84	5.92	6.99	41.15	5.72	38.06
75 % RDF +Azr	52.69	9.66	2.36	92.37	5.67	6.71	37.60	5.57	37.80
75 % RDF +PSB	52.07	9.40	2.29	90.66	5.81	6.52	39.35	5.51	37.48
C.D (P=0.05)	2.38	0.45	0.10	5.36	0.26	0.26	2.19	0.12	0.90
SE (d)	1.16	0.21	0.05	2.61	0.12	0.12	1.06	0.06	0.43

FYM= Farm Yard Manure, PoM= Poultry manure, VC= Vermicompost, PM= Pressmud, Azo= Azotobactor, Azr= Azospirillum, PSB=Phosphate Solubilising Bacteria

Table 2. Effect of inorganic, organic and bio-fertilizers on biochemical traits of onion.

Treatments	TSS (^{0}Brix)	Ascorbic acid (mg/100 g)	Pyruvic acid (µm/g)	Reducing sugar (%)	Non-reducing sugar (%)	Total sugars (%)
Control	14.03	11.84	3.71	3.35	6.08	10.14
RDF	13.92	11.27	4.89	3.11	5.91	10.08
FYM	15.70	13.09	3.57	5.32	7.07	12.34
PoM	15.51	12.68	3.72	5.07	6.83	12.16
VC	15.82	13.12	3.48	5.59	7.24	12.58
PM	15.66	12.82	3.67	5.19	6.86	12.21
50 % RDF +50% FYM	15.41	13.24	3.70	5.22	6.91	12.28
50 % RDF +50% PoM	15.15	12.90	3.79	4.81	6.71	11.87
50 % RDF +50% VC	15.58	13.35	3.68	5.37	7.16	12.48
50 % RDF +50% PM	15.28	13.11	3.77	4.92	6.76	12.04
50 % RDF +Azo	14.92	12.60	4.11	4.42	6.67	11.37
50 % RDF +Azr	14.96	12.66	4.16	4.49	6.63	11.24
50 % RDF +PSB	14.80	12.52	4.27	4.29	6.58	11.13
75 % RDF +Azo	14.51	12.30	4.47	3.94	6.30	10.59
75 % RDF +Azr	14.48	12.31	4.49	3.71	6.24	10.52
75 % RDF +PSB	14.36	12.23	4.53	3.69	6.23	10.37
C.D (P=0.05)	0.14	0.13	0.18	0.20	0.13	0.08
SE (d)	0.07	0.06	0.08	0.09	0.06	0.03

FYM= Farm Yard Manure, PoM= Poultry manure, VC= Vermicompost, PM= Pressmud, Azo= Azotobactor, Azr= Azospirillum, PSB=Phosphate Solubilising Bacteria