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Evaluation of The Performance of Onion cv. NHRDF Red 2 in Response to Inorganic, Organic and Bio-Fertilizers

KEYWORDS: Inorganic, Organic, Bio-fertilizers, Vermicompost, Pressmud, FYM

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ABSTRACT *An experiment was conducted to optimise the correct combination of organic and inorganic fertilizers for onion production cv. NHRDF Red 2during the rabiseason of 2013-14. 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 dose of NPK + 50% FYM and 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, Reducing Sugar, Non reducing Sugar and Total Sugars and minimum Pyruvic acid were also found in 100% vermicompost followed by 100% FYM. Therefore, it is concluded that judicial application of organic fertilizer (vermicompost) along with chemical fertilizer will produce higher yield along with quality bulbs at low cost of production*

INTRODUCTION

Onion is one of the important and flavoursdiffusing vegetable crop since a very period of time but for the last one decade it becomes an important export and foreign exchange earning crop. Conventional methods of fertilization have undoubtedly helped in improving both bulb yield and quality. But lately, routine management practices in India appear to be incapable of maintaining yields over the long-term. A gradual shift from using purely inorganic sources to introducing some proportion of organic fertilization is gaining acceptance.As the area of onion cultivation is continuously increasing to meet the demand of domestic as well as in international market,it is obvious that increasing cultivation requires more fertilizers. Intensive cultivation and excess use of chemical fertilizers resulted in harmful and long term impact on the health of soil and unstable yield of crops.Therefore, integrated nutrients management has become necessary for increasing productivity of onion by sustaining the soil productivity. So, for the last few years organic cultivation is gaining importance as a substitute of chemical fertilisation to reduce the high cost of cultivation and to sustain the fertility and productivity of soil also.In view of the following facts, an experiment was conducted to assess the effect of inorganic, organic and bio-fertilizers as compared to solely application of inorganic fertilizer, on onion production and quality.

MATERIALS AND METHODS

A field experiment was conducted to study the effect of chemical fertilizers, organic fertilizers and bio-fertiliser on yield and quality of onion cv. NHRDF Red 2 at the Horticulture Research Farm ofBabasahebBhimraoAmbedkar University, Lucknow, India, during 2013-14. The experiment was laid out in RBD design with three replications having 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) 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 performedasper standard method of Shwimmer& Westonand Total, Reducing and non-reducing sugars were analyzed by Lane and Eynon method.

RESULTS AND DISCUSSION

It is apparent from the data presented in Table 1 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 inT_8- 50% recommended dose of NPK + 50% VC followed by T_6- 50% recommended dose of NPK + 50% FYM havingplant height (55.92 cm), number of leaves (10.76), neck thickness (2.48 cm), bulb weight

Volume : 4 | Issue : 11 | November 2014 | ISSN - 2249-555X

(110.77 g), bulb length (6.57 cm), bulb diameter (7.22 cm), bulb size (46.85 cm^2), and T_1recommended dose of NPK for yield per plot (5.86 kg) and yield per hectare (39.92 t). T_6 was at par withT_1- recommended dose of NPK forplant height (54.73 cm), number of leaves (10.13) and bulb weight (107.66 g)were observed andT_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 forthese 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 tovermicompost 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 foundby (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 inorganics 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-fertilizerswith inorganic fertilizers in comparison to inorganic and organic manure combination might be due to 50% of inorganic fertilizerscannot be supplemented only through bio-fertiliser. This might be due to lack of organic matter in the soil and high pH because low organic matter and high pH bacterial population grow at very slow rate or sometimes no growthoccur.

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 findingsare 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 combination50% 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. 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.

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 (cm2)	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

Volume : 4 | Issue : 11 | November 2014 | ISSN - 2249-555X

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
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