

EFFECT OF SOURCES OF NUTRIENTS ON PHYSIOLOGICAL GROWTH PARAMETERS AND YIELD OF ONION VARIETIES

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ABSTRACT

The experiment was conducted at the Horticulture Nursery, College of Agriculture, Gwalior (M.P.) during rabi seasons of 2012-13 and 2013-14 to study the effect of organic and inorganic sources of nutrients on physiological growth parameters and productivity of onion varieties. Results revealed that Agrifound White registered significantly higher LA, LAI, RGR, CGR and NAR at every stage of growth. The significantly maximum LA was 615.0 cm² at 90 DAT, LAI 2.71 at 120 DAT, and maximum RGR 54.9 g/g/day at 30 DAT, CGR 7.75 g/cm²/day at 90 DAT and maximum NAR 2.56 mg/cm²/day at 30 DAT stages. Out of nutrient sources, 100% RDF (N₁₂₀P₈₀K₈₀) brought about significantly higher LA, LAI, RGR, CGR and NAR at every stage of growth over most of the treatments. The significantly maximum LA (969.7 cm²), LAI (4.76), RGR (59.3 g/g/day), CGR (9.12 g/cm²/day) and NAR (3.47 mg/cm²/day) were recorded at 30 and 90 DAT stages. The second and third best nutrient sources were 75% NPK + FYM and 75% + vermicompost, respectively at every stage of growth with respect to growth parameters. Consequently, the fresh yield of onion was found to be significantly higher (35.72 t ha⁻¹) from Agrifound White variety as against Agrifound Light Red. The net income was upto ₹ 94872 ha⁻¹. Amongst the organic and inorganic nutrient sources, 100% RDF (N₁₂₀P₈₀K₈₀) recorded significantly higher yield (42.53 t ha⁻¹) and net income (₹ 140108 ha⁻¹).

Keywords: Organics, inorganic sources, productivity, growth parameters, onion varieties

INTRODUCTION

Onion (*Allium cepa*) is the most important commercial vegetable crop grown all over the world. The crop is very useful for human beings because of its several nutritional and medicinal values. It occupies an important position among vegetable crops in kitchen garden as well as commercial production. It plays a vital role in Indian economy. The indiscriminate use of chemical fertilizers without organic manures is known to degrade physico-chemical as well as biological properties of the soil i.e. soil environment and soil health. On the other hand, the use of different type of organics improves soil properties, its health and fertilizer use efficiency, mitigates short supply of micronutrients, stimulates the proliferation of diverse group of soil microorganisms and improves the ecological balance of rhizosphere (Sanwal *et al.*, 2007; Saket *et al.*, 2014). The most common farmyard manure is well known as a store house of plant nutrients. Poultry manure is a good source of nutrients and each tonne of deep litter contain 29.40 kg nitrogen, 20.41 kg phosphorus and 20.41 kg potassium together with 6.8 kg magnesium, 6.8 kg sodium and 24.21 kg calcium (Channabasavanna and Biradar, 2002). Vermicompost being a rich source of macro and micronutrients and vitamins, plant growth regulators and beneficial microflora appeared to be the best organic source in maintaining soil fertility on

sustainable basis towards an eco-friendly environment (Edwards and Arancon, 2004). In fact, crop production is the practical means of tapping solar energy and converting it into food and other usable material through the production of leaves. The surface area of leaves per plant is the important determinant in the production of photosynthates. The leaf area index describes the functional size of assimilatory apparatus of plant stand and serves as a primary values for the calculation of other growth analysis parameters. Looking to the fact that production of leaves (photosynthetic surface area) depends on the supply of nutrients from the various sources; organic manures are gaining importance for sustainable crop production as well as for maintaining physico-chemical and biological properties of soil under eco-friendly environment. An experiment was, therefore, conducted to study the influence of organic and inorganic sources of nutrients on certain growth analysis parameters and the resultant onion yield.

MATERIALS AND METHODS

The field experiment was conducted at the Horticulture nursery, College of Agriculture, Gwalior (M.P.) during the rabi seasons of 2012-13 and 2013-14. The soil was sandyloam in texture having soil pH 7.9, electrical conductivity 0.13 dSm⁻¹, organic carbon 4.7 g kg⁻¹, available N, P₂O₅ and K₂O 214, 15 and 283 kg ha⁻¹, respectively. The rainfall received during the crop season was 54 and 205 mm in 2012-

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the general trend irrespective of the applied treatments. At 30 DAT stage, LA ranged from 13.0 to 74.7 cm² whereas it went up to maximum extent (218.2 to 969.7 cm²) at 90 DAT stage and then came down to 255.8 cm² to 695.7 cm² at the last stage. The leaf area index, in general, enhanced at the faster rate up to 90 DAT stage, thereafter very slight increase or decrease was noted. At the initial stage, it ranged from 0.10 to 0.38 which went up to 1.06 to 4.76 at 90 DAT stage and then 1.93 to 3.38 at 120 DAT stage. The relative growth rate (RGR), in general, tended to decrease with the increase in crop growth beyond 30 DAT stage. Thus, RGR which was found maximum (46.4 to 59.3 g/g/day) at 30 DAT stage went down (4.9 to 8.4 g/g/day) at 120 DAT stage. The crop growth rate (CGR), generally augmented at the faster rate up to 90 DAT stages, thereafter very slight changes were noticed irrespective of the treatments. At 30 DAT stage, CGR ranged from 0.99 to 1.86 g/cm²/day, whereas, it reached to the maximum extent (6.41 to 9.12 g/cm²/day) at 90 DAT stage. Later on, it was slightly decreased (6.00 to 8.84 g/cm²/day). The net assimilation rate (NAR) declined with the increase in the plant growth beyond 30 DAT stage. At the early stage, NAR was higher (0.46 to 3.47 mg/cm²/day) and then came down to the lowest values (0.08 to 0.30 mg/cm²/day) at 120 DAT.

RESULTS AND DISCUSSION

Growth parameters

The periodical observations (Table 1) indicate that the leaf area enhanced very fast upto 90 DAT stage, thereafter tended to decrease. This was

Table 1: Growth parameters of onion as influenced by varieties, treatments (Pooled for two years)

Treatments	Leaf area (cm ²)				Leaf area index				Relative growth rate (g/g/day)			
	30	60	90	120 DAT	30	60	90	120 DAT	30	60	90	120 DAT
Varieties												
Agrifound Light Red	45.4	212.0	608.0	462.6	0.20	1.07	2.58	2.65	53.0	18.0	13.5	6.6
Agrifound White	47.1	219.4	615.0	475.9	0.21	1.10	2.64	2.71	54.9	19.9	13.9	6.7
CD(P=0.05)	0.04	3.74	0.68	2.70	0.004	NS	0.019	NS	0.09	0.23	NS	0.06
Nutrient sources												
1.5 t PM ha ⁻¹	35.4	146.9	403.7	368.8	0.14	0.90	1.21	2.00	50.1	15.5	10.8	5.6
2.5 t FYM ha ⁻¹	39.5	187.3	434.9	399.8	0.14	0.81	2.22	2.54	51.1	16.5	11.6	6.0
5 t VC ha ⁻¹	37.2	165.0	447.0	385.3	0.14	0.79	2.22	2.50	49.5	16.8	11.5	5.7
2.5 t NC ha ⁻¹	32.7	135.9	328.2	327.4	0.12	0.72	1.19	1.95	48.2	15.9	10.7	5.4
50% RDF NPK	40.7	190.4	490.8	426.4	0.15	0.83	2.25	2.59	52.5	18.1	11.9	6.3
50% RDF+PM	43.1	201.2	600.4	451.0	0.19	1.00	2.40	2.64	53.8	19.0	12.6	6.5
50% RDF+FYM	45.7	224.1	705.8	479.0	0.21	1.41	2.62	2.79	55.5	19.9	13.6	6.7
50% RDF+VC	43.4	209.6	691.7	470.5	0.20	1.15	2.52	2.73	55.7	20.3	13.5	6.4
50% RDF+NC	41.8	195.1	536.1	432.8	0.17	0.92	2.29	2.61	54.2	18.8	12.5	6.4
75% RDF NPK	47.8	236.2	740.7	491.0	0.22	1.61	2.74	2.84	56.5	21.5	14.8	7.0
75% RDF+PM	55.8	245.3	756.8	553.8	0.23	1.20	3.19	2.96	57.3	20.9	16.2	7.5
75% RDF+FYM	68.6	316.5	889.5	649.1	0.31	1.29	4.12	3.37	58.7	21.8	17.9	8.2
75% RDF+VC	63.5	295.1	811.8	600.7	0.27	1.11	3.67	3.33	59.0	21.0	17.8	8.0
75% RDF+NC	51.9	212.4	727.7	521.4	0.23	1.04	3.20	2.94	55.4	21.3	14.9	7.4
100% RDF NPK (120:80:80)	74.7	411.7	969.7	695.7	0.38	2.02	4.76	3.38	59.3	23.2	18.0	8.4
Control	13.0	79.0	218.2	255.8	0.10	0.60	1.06	1.93	46.4	12.1	10.7	4.9

CD(P=0.05)	0.11	10.56	3.21	7.61	0.011	0.084	0.054	0.133	0.24	0.65	1.90	0.16
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PM = Poultry manure, FYM = Farmyard manure, VC = Vermicompost, NC = Neem cake

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The rise or fall in these physiological growth parameters with the advancement of plant growth is a naturally controlled phenomenon which may be influenced due to crop varieties and the nutrients supplied. Amongst the two varieties, Agrifound White registered significantly higher LA, LAI, RGR, CGR and NAR at every stage of growth. However, the maximum or minimum values of these parameters were not observed at the same growth stages. Growth analysis parameters are mainly governed genetically which resulted in such variability in the varietal traits (Shukla and Namdeo, 2000; Rajput *et al.*, 2004; Mahanthesh *et al.*, 2008). Out of nutrient sources, 100% RDF (N120P80K80) brought about significantly higher LA, LAI, RGR, CGR and NAR at every stage of growth. The significantly increase in these physiological attributes of onion from 30 to 90 or 120 DAT due to combined NPK fertilizer nutrition might be owing to the better availability of nutrients and effective conversion of multi-nutrients at the site

of photosynthesis into pigments (Sanjutha *et al.*, 2008). In fact the combined function of N, P and K nutrients might have maximum photosynthate accumulation towards the leaf biomass, because during initial stage, leaf is the most powerful sink than any other plant parts in the most of the crops. In fact leaf is the factory for the conversion of solar energy into the chemical energy by the process of photosynthesis. Thus, the number of leaves/plant (surface area of leaves) justifies the ultimate final expression of relative growth rate, crop growth rate and net assimilation rate of the growing plants. The diminishing response of onion to different organics (FYM, vermicompost, poultry manure and neem cake) as compared to inorganic NPK may be due to variation in their nutrient composition and delay in their nutrient release pattern for the actively growing plants. Out of applied organics, FYM performed the best, followed by vermicompost, poultry manure and then neem cake.

Table 2: Growth and yield of onion as influenced by various treatments (Pooled for two years)

Treatments	Crop growth rate (g/cm ² /day)				Net assimilation rate (mg/cm ² /day)				Bulb yield (t ha ⁻¹)
	30	60	90	120 DAT	30	60	90	120 DAT	
Varieties									
Agrifound Light Red	1.39	3.16	7.54	7.53	2.52	0.33	0.27	0.18	34.88
Agrifound White	1.45	3.24	7.75	7.73	2.56	0.35	0.28	0.19	35.72
CD(P=0.05)	0.025	0.030	0.23	0.018	0.020	0.012	0.010	0.015	0.05
Nutrient sources									
1.5 t PM ha ⁻¹	1.19	2.30	6.55	6.18	1.97	0.24	0.20	0.10	32.68
2.5 t FYM ha ⁻¹	1.27	2.54	6.89	7.12	2.24	0.27	0.23	0.13	33.55
5 t VC ha ⁻¹	1.24	2.40	6.74	6.94	2.22	0.25	0.21	0.16	33.09
2.5 t NC ha ⁻¹	1.15	2.22	6.51	6.07	1.94	0.23	0.18	0.09	32.34
50% RDF NPK	1.29	2.59	7.10	7.39	2.34	0.30	0.25	0.17	33.57
50% RDF+PM	1.35	2.75	7.75	7.79	2.62	0.31	0.27	0.19	34.75
50% RDF+FYM	1.41	3.45	8.04	8.02	2.86	0.34	0.29	0.21	35.59
50% RDF+VC	1.36	2.79	7.78	8.01	2.65	0.34	0.25	0.20	35.32
50% RDF+NC	1.30	2.64	7.65	7.61	2.42	0.31	0.24	0.17	34.39
75% RDF NPK	1.42	3.46	8.13	8.16	2.90	0.36	0.31	0.22	36.31
75% RDF+PM	1.61	3.77	8.20	8.43	2.78	0.38	0.35	0.24	38.08
75% RDF+FYM	1.86	5.42	8.84	8.63	3.46	0.52	0.37	0.28	40.69
75% RDF+VC	1.75	3.96	8.57	8.59	3.38	0.40	0.35	0.26	39.20
75% RDF+NC	1.59	3.65	8.08	8.33	2.96	0.37	0.33	0.22	37.00
100% RDF NPK (120:80:80)	1.86	5.46	9.12	8.84	3.47	0.58	0.38	0.30	42.53
Control	0.99	1.86	6.41	6.00	0.46	0.22	0.15	0.08	25.89
CD(P=0.05)	0.07	0.08	0.63	0.05	0.05	0.03	0.03	0.04	0.15

Productivity of onion

The data (Table 2) indicate that the fresh yield of Agrifound while was found significantly higher (35.72 t ha⁻¹) over Agrifound Light Red (34.88 t ha⁻¹) which may be due to increased physiological growth parameters. In this respect, the variety

Agrifound White took a lead over Agrifound Light Red with high remobilization of accumulated assimilates to develop underground bulb. Thus, the productivity parameters are based on the cumulative effect of the genetic ability and production efficiency of the varieties, their fertility management and the

agro-climatic conditions where these varieties are grown. The maximum yield of onion (42.53 t ha⁻¹) was recorded at N₁₂₀P₈₀K₈₀, being significantly higher to all the preceding nutrient sources. The second best

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nutrient source was 75% NPK + FYM, followed by 75% NPK + vermicompost and then 75% NPK + poultry manure. The increase in productivity of onion due to nutrient combinations was mainly as a result of increased physiological growth parameters as well as photosynthesis thereby increasing translocation of organic food materials towards the sink. The significant variation in onion yield due to applied organic sources of nutrients alone or with NPK might be owing to variations in their nutrient composition,

decomposition of organic residues, C:N ratio, nutrient release pattern, climate and soil characteristics (Dhama, 2003 and Sanwal *et al.*, 2007). The organics when applied alone (without NPK) performed in the lower range which might be owing to slow release pattern of major nutrients for the actively growing plants. These results agree with those of Yadav and Yadav, (2010); Singh *et al.*, (2011), Ethel *et al.*, (2011) and Naik *et al.*, (2013).

Table 3: Economics of onion as influenced by varieties, treatments (Pooled for two years)

Treatments	Gross income (₹. ha ⁻¹)	Net income (₹. ha ⁻¹)	Additional net income over control	B:C ratio
Varieties				
Agrifound Light Red	174424	90687	--	2.11
Agrifound White	178609	94872	4185	2.16
CD (P=0.05)	--	--	--	--
Nutrient sources				
1.5 t PM ha ⁻¹	163375	80630	8900	1.98
2.5 t FYM ha ⁻¹	167775	90030	28300	2.16
5 t VC ha ⁻¹	165475	72730	11000	1.79
2.5 t NC ha ⁻¹	161675	68930	7200	1.75
50% RDF NPK	167862	97988	36258	2.41
50% RDF+PM	173750	88875	27145	2.05
50% RDF+FYM	177962	98088	36358	2.23
50% RDF+VC	176537	81663	19933	1.87
50% RDF+NC	171950	77075	15345	1.82
75% RDF NPK	181500	110560	48830	2.56
75% RDF+PM	190375	104435	42705	2.22
75% RDF+FYM	203450	122510	60780	2.52
75% RDF+VC	196000	100060	38330	2.05
75% RDF+NC	185000	89060	27330	1.93
100% RDF NPK (120:80:80)	212112	140108	78378	2.95
Control	129475	61730	--	1.92
CD (P=0.05)	--	--	--	--

Economics

The data (Table 3) revealed that the Agrifound White gave maximum net income (₹. 94872 ha⁻¹) with B:C ratio 2.16. This variety gave additional net income of ₹. 4185 ha⁻¹ over Agrifound Light Red variety. The net income was in accordance with the yield of the varieties. Out of nutrient sources 100% NPK (N₁₂₀P₈₀K₈₀) gave highest net returns of ₹. 140108 ha⁻¹ (2.95), being higher by ₹. 78378 ha⁻¹ over control. The second best nutrient source was

75% NPK + FYM giving extra benefit by ₹. 60780 ha⁻¹ over control. Application of 75% NPK earned extra benefit ₹. 48830 ha⁻¹ over control. The net income obtained from organics applied alone or with 50% NPK was in the lower range which was owing to increased cost of organics.

It is concluded that out of, Agrifound White, recorded maximum physiological growth parameters, yield and net income under 100% NPK addition.

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