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EFFECT OF ORGANIC SOURCES OF NUTRIENTS ON GROWTH, YIELD AND QUALITY OF LENTIL GENOTYPES

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ABSTRACT

A field experiment was conducted during winter seasons of 2009-10 and 2010-11 at Rewa to study the effect of triacontanol, vermicompost and biofertilizers on growth, yield and quality of lentil genotypes. Treatments comprised four genotypes and six organics. Amongst the lentil genotypes, VL-508 gave maximum LAI, CGR, NAR and chlorophyll content in leaves as well as grain yield (12.08 q ha^{-1}) with the net income of Rs.23730 ha^{-1}. Amongst the organics, vermicompost (4 t ha^{-1}) with Rhizobium + phosphate-solubilizing bacteria recorded significantly higher physiological parameters and grain yield (12.36 q ha^{-1}), but the highest net income (Rs.20270 ha^{-1}) was obtained from biofertilizers alone instead of triacontanol or vermicompost. The net income was further augmented when VL 508 was grown with these organics particularly with biofertilizers alone (Rs. 27204 ha^{-1}).

Key words: Lentil genotypes, organic sources, growth, yield, quality

INTRODUCTION

Lentil (*Lens culinaris* Medikus) commonly known as *Massor* is one of the important pulse crops of Madhya Pradesh. The varieties with higher dry matter production and its proper distribution towards reproductive organs results in higher productivity. Dry matter production can be increased by selecting varieties with high photosynthetic rate. The rate of photosynthesis can be increased by proper fertilizer nutrition which in turn increases the chlorophyll content of leaves and leaf area. Plant growth regulators like triacontanols (long-chain aliphatic alcohols) have been found to increase crop yields upto 56% (Mishra *et al.* 2003). The yield of many pulses crops have been found to increase significantly due to triacontanol-Vipul (Chaurasia and Chaurasia, 2008). Vermicompost being a rich source of macro and micronutrients, vitamins, PGR's 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). The information on these aspects was lacking, hence, the present research was taken up on lentil for this region.

MATERIALS AND METHODS

The field experiment was conducted during *rabi* seasons of 2009-10 and 2010-11 at the Private Agriculture-cum-Research Farm, Beenda-Semariya Road, Rewa (M.P.). The soil of the experimental field was clay-loam having pH 7.5, electrical conductivity 0.32 dS m^{-1}, organic carbon 8.6 g kg^{-1}, available N 230.2 kg ha^{-1}, available P_2O_5 13.8 kg ha^{-1}, available K_2O 371.7 kg ha^{-1} and available S 20.5 kg ha^{-1}. The rainfall received during the winter months was 78.8 and 101.8 mm in both the years. The treatments comprised four lentil genotypes (H-1, JL-3, PL-7 and VL-508) in main plots and six organics (absolute control, triacontanol, biofertilizers *Rhizobium* + PSB, triac. + biof. vermicompost with and without biofertilizers) in sub-plots. The experiment was laid out in split-plot design with three replications. Lentil genotypes were sown on 2 November, 2009 and 4 November, 2010 @ 35 kg seed ha^{-1} at 30 cm row spacing. A uniform dose of 20 kg N and 50 kg P_2O_5 ha^{-1} was applied through diammonium phosphate and 20 kg S ha^{-1} through elemental sulphur as basal in all the treatments. Before sowing, a seed were inoculated with Rhizobium biofertilizer @ 20 g kg-1 seed and during sowing PSB (phosphate-solubilizing bacteria) was also applied in the same furrows @ 20 g kg^{-1} seed mixed with FYM as per treatments. The crop was grown as per recommended package of practices. Plant growth regulator i.e. triacontanol (Vipul) was foliar sprayed (thrice) @ 250 ml/ha during 30, 40 and 50 days after sowing. The crop was harvested on 22 February, 2010 and 3 March, 2011. The chlorophyll content in leaves was estimated at 60 days stage by acetone extraction method (Witham *et al.*, 1971). Observations on DM production, leaf area/plant, LAI, CGR and NAR were recorded. The protein content in grain was determined by multiplying the per cent N content in grain with 6.25 (A.O.A.C., 1997).

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RESULTS AND DISCUSSION

Physiological parameters

Amongst the lentil genotypes, VL 508 recorded slightly higher DM production, leaf area/plant and significantly higher other parameters viz. LAI, CGR, NAR and chlorophyll content in leaves over other genotypes. This may be due to rapid plant growth and development of new leaves in VL 508 which were photosynthetically more active. Thus, the maximum leaf area in VL 508 induced competition for light and shadding of leaves. The significant differences in physiological parameters in different genotypes might be owing to their genetic variability. Chlorophyll content in leaf tissue varies with species, age of plants and growth seasons (Yurkovskii *et al.*, 1977). Increase in chlorophyll content with age of plants is a general phenomenon, which is due to high magnesium and protein contents of leaves (Srivastava *et al.*, 2012). Amongst the organics, vermicompost + biofertilizers resulted in significantly higher physiological parameters. This was followed by vermicompost and triacontanol + biofertilizers. The increased supply of multi plant nutrients from vermicompost + biofertilizers resulted in enhanced photosynthetic process. In fact, leaf is the factory for conversion of solar energy into chemical energy by the process of photosynthesis.

Table 1: Physiological parameters of lentil at different growth stages as influenced by genotypes and fertility levels (Pooled for 2 years)

Treatments	Dry matter production (g/m^2)	Leaf area/ plant (cm^2)	Leaf area index	Crop growth rate (g/m^2/day)	Net assimilation rate (mg/m^2/day)	Chlorophyll mg/g fresh leaf weight		
						a	b	Total
Genotypes								
H-1	90.99	102.88	1.120	0.83	35.50	1.105	1.125	2.235
JL-3	91.72	100.52	1.100	0.84	35.96	1.135	1.145	2.280
PL-7	90.86	101.99	1.140	0.85	35.45	1.170	1.180	2.355
VL-508	95.72	106.79	1.240	0.89	37.08	1.215	1.220	2.430
CD (P=0.05)	NS	NS	0.087	0.006	0.24	0.0122	0.0124	0.025
Organics								
Absolute control	74.22	86.29	0.900	0.71	32.92	1.100	1.110	2.210
Triacontanol	85.02	101.09	1.070	0.88	34.70	1.25	1.135	2.260
Biofertilizers	87.81	97.36	1.030	0.80	34.92	1.155	1.160	2.315
Triac. + Biof.	94.36	100.16	1.140	0.90	36.69	1.135	1.170	2.305
Vermicompost	99.98	111.62	1.260	0.88	37.11	1.200	1.205	2.405
Vermi. + Biof.	112.49	120.62	1.500	0.95	39.65	1.215	1.225	2.445
CD (P=0.05)	4.10	13.70	0.085	0.007	0.24	0.0126	0.0125	0.044

The beneficial effect of vermicompost on physiological parameters is the result of its usefulness as a store-house of plant nutrients. It is a rich source of macro and micronutrients, vitamins, PGPR's and beneficial microflora, thereby increased microbial and biological activity in the rhizosphere (Edwards and Arancon, 2004). The applied triacontanol might have favourably influenced the physiological and biochemical activities of crop plants, growth of young leaves which helped in the synthesis of carbohydrates, proteins etc. for building up new tissues.

Yield-attributes and yield

The number of pods/plant, seeds/pod, 1000-seed weight and seed weight/plant were significantly higher in VL-508 over other genotypes. The higher yield attributes of VL-508 may be owing to maximum increase in dry matter production, physiological growth parameters as well as chlorophyll contents in leaves. The variations in these parameters among the varieties are mainly due to the fact that such parameters are genetically governed. The present findings are in consonance with those of other researchers (Chauhan and Singh, 2001; Singla *et al.*, 2006). The grain yield and harvest index were found significantly higher (12.08 q ha^{-1} and 46.89%, respectively) in VL 508 over the remaining genotypes. This may be due to higher yield attributes of this genotype. The productivity parameters are based on the cumulative effect of the genetic ability and production efficiency of the genotypes, their fertility management and the agro-climatic conditions where the genotypes are grown. The best performance of VL 508 over others might be ascribed to its physiological role in synthesis and partitioning of the biomass (Patel *et al.*, 2012). The combined

Table 2: Productivity, seed protein and economics of lentil as influenced by genotypes and organics (Poled for 2 years)

Treatments	Number of pods/ plant	Number of seeds/ pod	1000-seed weight (g)	Seed weight/ plant (g)	Straw weight/ plant (g)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index (%)	Net income (Rs ha^{-1})	B:C ratio	Differen-ces over control (Rs./ha)	Seed protein (%)
Genotypes												
H-1	48.94	1.49	30.25	4.47	8.00	9.72	13.90	41.06	15514	1.80	-	24.16
JL-3	61.70	1.53	30.38	4.90	7.91	8.90	17.26	38.94	12656	1.66	-	23.98
PL-7	61.82	1.54	30.02	5.27	7.78	9.80	13.51	42.07	15717	1.82	-	24.13
VL-508	65.70	1.56	30.22	5.08	7.91	12.08	13.69	46.89	23730	2.23	-	24.16
CD (P=0.05)	1.69	0.009	0.119	0.068	0.088	0.77	0.12	0.88	-	-		NS
Organics												
Absolute control	40.32	1.36	27.56	4.03	6.69	7.84	10.38	42.90	12318	1.77	-	23.74
Triacontanol	50.25	1.45	29.26	5.05	7.92	9.21	13.79	39.83	15459	1.85	3141	23.93
Biofertilizers	60.86	1.46	29.66	4.76	7.78	10.06	14.11	41.50	20270	2.24	7952	23.90
Triac. + Biof.	65.22	1.55	30.85	5.18	8.22	10.38	14.62	41.41	19450	2.06	7132	24.12
Vermicompost	67.93	1.61	30.99	5.08	7.89	10.90	14.91	42.20	14498	1.58	2180	24.43
Vermi. + Biof.	72.97	1.74	32.99	5.47	8.91	12.36	15.08	44.99	19430	1.77	7112	24.52
CD (P=0.05)	1.70	0.009	0.124	0.064	0.081	1.07	0.10	0.8	-	-		0.09

application of vermicompost + biofertilizers resulted in significant rise in all the yield-attributes over the other treatments. However, the second best treatment was vermicompost or triacontanol with biofertilizers. The higher yield attributes under these treatments might be due to increased growth and physiological parameters including chlorophyll contents in leaves as a result of increased supply of all the essential plant nutrients as well as improved physico-chemical and biological properties of the soil. All these favourable situations eventually brought about greater accumulation of carbohydrates, proteins and their translocation to the reproductive organs which in turn increased the yield components. Consequently the yield parameters were also found in the higher range in the above mentioned treatments. These results are in close agreement with those of Hakeem *et al.* (2007), Kumawat *et al.* (2009), Kumawat and Kumawat (2009), Subbaiah *et al.* (2009), Kumar *et al.* (2010) and Sharma and Kushwah (2011). Among the treatment interactions, VL 508 with vermicompost + biofertilizers further encouraged the yield attributes thereby grain and straw yields upto 13.9 and 15.6 q ha^{-1}, respectively (Table 3).

Table 3: Effect of organics and genotypes on productivity and economical parameters of lentil

Organics	Genotypes				Genotypes			
	H-1	JL-3	PL-7	VL-508	H-1	JL-3	PL-7	VL-508
	Grain yield (q ha^{-1})				Straw yield (q ha^{-1})			
Absolute control	7.3	7.0	7.7	9.4	11.5	10.2	9.7	11.1
Triacontanol	8.3	7.7	9.1	11.7	13.2	14.9	13.8	13.3
Biofertilizers	9.6	8.7	9.8	12.1	14.5	14.6	13.7	13.6
Triac.+ Biof.	9.9	9.2	10.0	12.4	14.9	15.2	14.4	14.0
Vermicompost	10.6	9.4	10.4	13.1	15.3	15.1	14.8	14.7
Vermi. + Biof.	12.6	11.3	11.7	13.9	15.0	15.1	14.7	15.6
CD (P=0.05)		2.14				0.21		
	Net income(Rs. ha^{-1})				Benefit:Cost ratio			
Absolute control	10365	9479	11598	17830	1.64	1.59	1.72	2.11
Triacontanol	12200	10417	15070	24146	1.67	1.57	1.83	2.33
Biofertilizers	18723	15706	19446	27204	2.15	1.96	2.19	2.67
Triac.+ Biof.	17810	15410	18141	26438	1.97	1.84	1.99	2.44
Vermicompost	13568	9336	13097	21989	1.54	1.37	1.52	1.88
Vermi. + Biof.	20415	15585	16948	24770	1.81	1.62	1.67	1.98

Grain protein and net income

Amongst the genotypes, the grain protein was found to be in the similar range (23.98 to 24.16%), however the net income was maximum from VL 508 (Rs.23730/ha). The net income from other genotypes ranged from Rs.12656 to Rs.15717/ha. Amongst the fertility treatments, vermicompost + biofertilizers registered the almost significantly higher grain protein (24.52%), followed by vermicompost alone (24.43%). However, the maximum net income

(Rs.20270/ha) was secured from biofertilizers alone. This was closely followed by vermicompost or triacontanol with biofertilizers (Rs.19430 to 19450/ha). The net income was further enhanced when VL 508 was grown with these fertility levels i.e. Rs. 24770 to Rs. 27204 ha^{-1} (Table 3). The higher grain protein in VL 508 may be owing to the increased synthesis of protein through amino acids as a result of N-metabolism (Dwivedi and Bapat, 1998). The response of vermicompost with biofertilizers in improving seed quality may be attributed to their significant role in regulating the photosynthesis, root enlargement and better microbial activities (Pathak *et al.*, 2003; Chaurasia and Chaurasia, 2008). The findings conclude that VL 508 grown with biofertilizers alone proved highly remunerative for Rewa region of Madhya Pradesh.

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