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ROLE OF MORPHO-PHYSIOLOGICAL ATTRIBUTES ON YIELD IN LENTIL

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ABSTRACT

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The experiment was carried out in Rabi season (November-March) of 2008-09 at the experimental farm of Bangladesh Institute of Nuclear Agriculture, Mymensingh ($24^0$75´ N latitude and $90^0$50´ E longitude) to investigate variability and correlation for morpho-physiological, yield attributes and yield in 16 lentil mutants/cultivar. Results revealed that high yielding genotypes, in general, showed taller plant, higher number branches plant^{-1}, greater leaf area index (LAI), total dry mass (TDM) plant^{-1} and absolute growth rate (AGR) than in the low yielding ones. In terms of seed yield, two mutants, LM-31 and LM-44 produced higher seed yield attributed for higher number of pods plant^{-1} and bolder seed sizes. In contrast, LM-135 and LM-201 produced lower seed yield due to production of fewer pods and smaller seed sizes. Seed yield and pod number had highly positive and significant correlation with branch number and TDM, and TDM depends on branch number, LAI and AGR indicating yield could be increased by increasing dry matter production through increased LAI and AGR. Hence, these traits could be used for the improvement of seed yield resulting in the evolution of high yielding varieties of lentil.

Keywords: *lentil, variability, growth, correlation*

INTRODUCTION

A lot of research has been done to increase the present yield of grain legumes including lentil (*Lens esculenta* Moench). But so far, no breakthrough has occurred in the yield ceiling of these crops. Inspite of the best efforts for improving the lentil varieties, yield of this crop remain low. Several studies have been made to understand their performance which mainly includes the contribution of various yield components towards yield. The studies indicate the presence of positive correlations between pod number, seeds pod^{-1} and seed size with yield (Chauhan and Singh, 2001; Kumar *et al.* 2002; Yadav *et al.* 2003; Younis *et al.* 2008). These attributes in turn depend on morpho-physiological characters (Dutta and Mondal, 1998). However, the information on the genotypic plasticity of morpho-physiological characters and its relationships with the major yield components in lentil are scarce. On the other hand, component characters for yield are interdependent to each other while one character may express at the expense of other (Chauhan and Sinha, 1988; Anjam *et al*. 2005; Kakde *et al*. 2005). The importance of correlation in any breeding programme is well documented for various crop species as if provides a basis for effective selection. Correlation index acts as a guide to the reliability of phenotypic and genotype values and determines success in crop improvement. Therefore, an attempt has been made to assess correlation of various morpho-physiological attributes of seed yield in some genotypes of lentil.

MATERIALS AND METHODS

Fifteen lentil mutants along with a mother were grown in Rabi season (November-March) of 2008-09 at the experimental farm of Bangladesh Institute of Nuclear Agriculture, Mymensingh ($24^0$75´ N latitude and $90^0$50´ E longitude), Bangladesh. A randomize complete block design with three replications was followed. A unit plot size of 2.0 m × 1.8 m with plant spacing of 30 cm × 5-7 cm was used. Seeds were sown on 10 November 2008. Urea, triple superphosphate and muriate of potash were used as a source of nitrogen, phosphorus and potassium at the rate of 40, 80 and 60 kg ha^{-1}, respectively at the time of final land preparation. Cultural practices were done as and when necessary for normal plant growth and development. The physiological parameters such as leaf area index, total dry mass production, absolute growth rate and chlorophyll content in leaves were recorded during flowering and pod setting stages. Other yield contributing character and yield were recoded at harvest. Leaf area index was measured by canopy analyzer (Model: L I 2000, USA). The total dry mass plant^{-1} was estimated by summing dry matter of leaves, stem, root and pod per plant. Absolute growth rate was estimated following the method of Hunt (1978). Leaf chlorophyll was estimated following the method of Yoshida *et al*. (1976). Simple correlation co-efficient was estimated according to Johnson *et al.* (1955). The collected data were analyzed using the statistical computer package programme, MSTAT-C.

RESULTS AND DISCUSSION

Morpho–physiological attributes

The effect of genotypes on morpho-physiological character showed highly significant differences in lentil (Table 1). Results revealed that high yielding genotypes, in general, showed greater plant height, branch number, leaf area index (LAI), total day mass (TDM) production, absolute growth rate (AGR) and chlorophyll content in leaves than in low yielding ones. Two genotypes, LM-31 and LM-44 showed significantly higher plant height, branch number, LAI, TDM, AGR and chlorophyll content in leaves with LM-44 being the highest of all. In contrast, LM-201 and LM-68 showed lower number of branches, LAI, TDM, AGR and chlorophyll content in leaves. The remainder genotypes formed different intermediate groups. These results are in consistent of many workers (Dutta *et al*. 1998; Samad and Roy, 2002; Mondal *et al*. 2007). The authors reported that high yield genotypes had taller plant, profuse brunching habit, larger photosynthetic area and TDM than in low yielding ones.

Table 1. Variations in morpho-physiological characters in 16 lentil mutants/cultivar

Genotypes	Plant height(cm)	Branches plant^{-1}(no.)	Total dry mass plant^{-1} (g)	Leaf area index	Absolute growth rate (mg plant^{-1} day^{-1})	Chlorophyll (mg g^{-1}fw)
LM-2	27.7	17.9	6.82	2.17	86.5	2.04
LM-10	27.1	14.3	6.48	2.01	70.4	1.99
LM-17	27.5	16.1	6.79	2.12	84.0	2.04
LM-31	28.6	23.4	8.15	3.47	131.7	2.29
LM-44	29.6	28.0	8.20	3.57	181.0	2.19
LM-51	26.3	11.4	4.82	1.37	35.6	1.71
LM-56	27.0	12.1	5.51	2.00	68.0	1.92
LM-65	23.0	15.5	6.68	2.09	71.3	2.01
LM-68	25.7	10.1	4.66	0.99	22.8	1.59
LM-73	27.7	19.3	8.11	2.54	98.0	1.88
LM-84	28.0	22.6	8.12	2.65	114.8	1.91
LM-110	26.8	12.5	5.27	1.45	54.6	1.94
LM-114	21.7	12.5	5.11	1.38	53.6	1.78
LM-135	26.9	13.2	5.34	1.87	62.0	2.30
LM-201	15.1	10.7	4.54	1.05	18.0	1.42
Utfala	27.3	15.5	7.69	2.21	89.6	1.93
LSD (0.05)	1.32	1.10	0.61	0.22	8.13	0.38
CV (%)	3.23	8.15	6.49	6.46	8.17	8.31

Yield contributing characters

The effect of genotypes on yield attributes and yield was highly significant (Table 2). The range of pods plant^{-1}, seeds pod^{-1}, 1000-seed weight, seed and biological yield and harvest index was 50-137, 1.50-1.68, 12.99-20.50g, 570-2410 kg ha^{-1}, 2250-6751 kg ha^{-1} and 18.2-37.3%, respectively. Results revealed that high yielding genotypes showed increased number of pods plant^{-1}, seed pod^{-1} and bold size seed than the low yielding ones. In contrast, low yielding genotypes produced fewer pods plant^{-1} and smaller seed size. Three genotypes, LM-31, LM-44 and LM-84 produced significantly higher number of pods plant^{-1} (range 124-137) and seeds pod^{-1} (range 1.60-1.68) with LM-44 was the highest of all. In contrast, four genotypes, LM-68, LM-114, LM-135 and LM-201 produced fewer pods plant^{-1} (range 50-83) while LM-201 produced the lowest (50). The remainder genotypes formed different intermediate groups and genotypes also differed significantly with in a particular group. The higher seed yield was observed in LM-31 and LM-44 and these two genotypes hold similar statistical rank although showed significantly different from the remainders. The yield was higher in those genotypes because of attributed higher number of pods plant^{-1}, seeds pod^{-1} and bolder seed size. However, LM-84 produced higher number of pods plant^{-1} and seeds pod^{-1} but showed medium seed yield (1353 kg ha^{-1}) due to smaller size seeds. In contrast, LM-135 produced lowest seed yield (570 kg ha^{-1}) which was statistically similar to LM-201. These results agrees with many workers (Kumar *et al.* 2002; Yadav *et al.* 2003; Anjam *et al.* 2005; Younis *et al.* 2008) in lentil who reported that high yielding genotypes produced higher number of pods plant^{-1}.

Table 2. Genotypic effect on yield attributes and yield in lentil

Genotypes	Pods plant^{-1} (no.)	Seeds pod^{-1} (no.)	1000-seed weight (g)	Seed yield (kg ha^{-1})	Biological yield (kg/ha)	Harvest index (%)
LM-2	106	1.60	18.11	1719	5555	30.9
LM-10	102	1.58	18.55	1489	4955	30.1
LM-17	105	1.56	19.21	1606	5326	30.1
LM-31	126	1.68	20.16	2355	6751	34.9
LM-44	137	1.60	20.50	2410	6461	37.3
LM-51	79	1.55	14.92	1476	6451	22.9
LM-56	100	1.57	18.78	1510	4786	31.6
LM-65	104	1.58	18.24	659	2250	29.3
LM-68	68	1.50	16.20	824	3319	24.8
LM-73	120	1.55	17.67	1834	6363	28.8
LM-84	124	1.64	16.60	1353	2522	33.8
LM-110	90	1.55	12.99	840	3422	24.5
LM-114	83	1.55	15.51	954	3717	25.7
LM-135	93	1.54	16.24	570	2684	28.3
LM-201	50	1.50	14.81	760	3135	18.2
Utfala	117	1.54	17.58	1764	6146	28.7
LSD (0.05)	13.4	0.21	1.08	175	438	3.09
CV (%)	7.71	5.92	3.39	5.65	5.54	6.47

Correlation coefficient

Seed yield showed significant and positive correlation with plant height (r=0.56**), branch number (r=0.66**). TDM production (r=0.65**), AGR (r = 0.71**), LAI (r=0.73**), chlorophyll content in leaves (r=0.47**), pods number (r=0.66**), seeds pod^{-1} (r = 0.67**) and 1000-seed weight (r=0.57**) (Table 3). Further, seed yield was positively and significantly correlated with TDM, and TDM depends on LAI (r = 0.91**) and AGR (r= 0.89**) indicating yield could be increased by increasing dry matter production through increased LAI and AGR. DM is the end product of many plant processes where LAI plays central role (Mondal 2007). Pod number showed significant and positive association with plant height (r=0.77**), branch number (r=0.87**), TDM (r=0.93**), AGR (r=0.81**), LAI (r=0.93**) and chlorophyll (r=0.57**). This suggests increase plant height, brunch number, LAI and TDM would produce increase pod yield and agrees with result of Mondal *et al.* (2007) in lentil, who also observed pod number increased with increasing branch number, LAI and TDM. However, pod number strongly correlated with TDM, and TDM depend on branch number and AGR (r=0.89**) suggests that pod production depend on branch number and AGR. Finally, the present investigation suggests that higher of number of branches, LAI, TDM and pod number could be good index of selection for lentil improvement.

Table 3. Simple correlation co-efficient among different characters of 16 lentil mutants

Characters	Seed yield	Plant height	Branch No.	LAI	TDM	AGR	Chl.
Plant height (cm)	0.56**	-	-	-	-	-	-
Branch number plant^{-1}	0.66**	0.55**	-	-	-	-	-
Leaf area index (LAI)	0.73**	0.63**	0.86**	-	-	-	-
Total dry mass (TDM) plant^{-1} (g)	0.65**	0.60**	0.89**	0.91**	-	-	-
Absolute growth rate (AGR) (mg plant^{-1} day^{-1})	0.71**	0.64**	0.97**	0.77**	0.89**	-	-
Chlorophyll (Chl.) (mg g^{-1}fw)	0.47**	0.39*	0.35*	0.18	0.45**	0.53**	-
Pod numbers plant^{-1}	0.66**	0.77**	0.87**	0.93**	0.93**	0.81**	0.57**
Seed numbers pod^{-1}	0.67**	0.38*	0.27*	0.55**	0.49**	0.55**	0.41**
1000-seed weight (g)	0.57**	0.54**	0.39*	0.44*	0.38*	0.41*	0.47**

n= 48; *, ** significant at 5% and 1% level of probability, respectively

CONCLUSION

Among the studied mutants/cultivar, LM-44 and LM-31 showed superiority in morpho-physiological characters which resulted higher seed yield. This information may be used for future plant breeding programme in lentil.

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