RESPONSE OF LINSEED (*LINUM USITATISSIMUM* L.) VARIETIES TO VARYING FERTILITY AND IRRIGATION LEVELS IN VERTISOLS OF SOUTH-EAST RAJASTHAN

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Abstract: A field experiment was conducted during *rabi* seasons of 2000-01 and 2001-02 at Agricultural Research Station, Ummedganj, Kota to find out the suitable variety of linseed for fertility and irrigation. The experiment consistent of 24 treatment combinations, comprised of 2 varieties (Meera and Rashmi), 3 irrigation schedules (IW/CPE of 0.3, 0.5 and 0.7) kept in main plots and 4 fertility levels (0 kg N + 0 kg P_2O_5 ha^{-1}, 40 kg N+ 20 kg P_2O_5 ha^{-1}, 80 kg N + 30 kg P_2O_5 ha^{-1} and 120 kg N + 40 kg P_2O_5 ha^{-1}) in sub plots in spilt plot design with 3 replications. Maximum seed yield, contents of N, protein and oil and oil yield was recorded in Meera as compared to Rashmi. Significantly higher seed yield (15.47 q/ha) was recorded at IW/CPE of 0.5 which was 20.11 % higher than IW/CPE of 0.3. Significantly and maximum higher oil yield (662 kg/ha) and protein content (11.98 %) was recorded at IW/CPE of 0.5 and per cent increased was 11 and 10.7 over IW/CPE of 0.3. The higher seed yield (17.48 q/ha) was recorded by application of 80 kg N + 30 kg P_2O_5/ha, which was 22.2 and 92.1 % higher over 80 kg N +20 kg P_2O_5 /ha and no fertilization. The oil content (42.80) and oil yield (753.60 kg ha^{-1}) also significantly increased by 3.62 and 12.2, 26.82 and 115.70 per cent at 80 kg N +30 kg P_2O_5/ha over 40 kg N +20 kg P_2O_5/ha and 0 kg N +0 kg P_2O_5/ha, respectively.

Keywords: N content, Oil yield, Protein content, Seed yield

INTRODUCTION

Linseed (*Linum usitatissimum* L.) is an ancient world crop cultivated by man for its seed and fiber**.** Every part of linseed is utilized commercially either directly after processing. The two products of seed are linseed oil and linseed meal. The oil content of the seed generally varies from 33 to 45 (per cent) nearly 80 per cent oil goes to industries due to high level of lanoline acid (nearly 50 per cent) which provides rapid drying properties for manufacture of paints, varnish, oil, cloth, water proof fabrics, linoleum, pad ink, printing ink etc. Higher amount of linolenic acid is also suggested to reduce serum cholesterol and even cancer (Chan *et al*., 1991). However, linolenic acid readily auto oxidizes to produce off flavors or rancidity and makes oil unstable for cooking purposes in order to convert into edible oil linolenic acid needs to reduced below 5 per cent level (Green and Marshal, 1981). About 20 per cent of the total oil produced is used in farmer's homes. Its cake containing nearly 35 per cent protein is a feed of high nutritional value for milch animals and also good concentrated organic manure for eco-friendly agriculture. The linseed oil is used in process of cementing roads (Walsh, 1965) and in antibiotics (Anonymous, 1968) antibiotics linatine found in the seeds of linseed could cure disease in men and animals against which there in non medical treatment.

In India among the oil seed crops grown during *rabi*, linseed is next in importance to rapeseed and mustard in area as well as in production. This crop is often grown on marginal and sum marginal soils as rain fed as pure or mixed intercrop but in the light of recent research due to development of new high yield verities it is also being grown good soils under irrigated and high fertility conditions. Major linseed growing district in Rajasthan Kota, Bundi, Jhalawar parts of Tonk, Swaimadhopur, Chittorgharh, Banswara and Udaipur. This crop has great potential for improvement in Rajasthan. The main region for low yield appears to be low soil moisture and nutrient status, particularly at different crop growth stages, since the crop the mostly grown on conserved soil moisture where application of nutrient is almost negligible. Recently, several high yielding verities of the crop have been released which produced seed yield more than 20 q/ha. Thus, these verities have turned this crop into a highly remunerative crop. It is imperative to select a best suited variety of the crop for agro climatic zone–V of Rajasthan. Among the agronomic practices known to augment the crop yield, moisture supply is of vital importance. Water deficits can however, reduce yield seriously if they occur at certain critical periods during the growth of the crop (GopalKrisna e*t al*., 1996). Though a quite good deal of research has been carried out in India on nitrogen and phosphorus fertilization in linseed crop, only a limited work has been done involving high yielding verities in moisture regimes.

In the light of above facts and paucity of adequate experimental evidences in the state of Rajasthan, present investigation was undertaken to evaluate performance new linseed varieties for irrigation schedules and fertility levels.

MATERIAL AND METHOD

The field experiment was conducted during *rabi* seasons (2000-01 & 2001-02) at Agricultural Research Station, Ummedganj, Kota. The experiment was carried out in split plot design comprised of 2 varieties (Meera and Rashmi), 3 irrigation schedules

(IW/CPE of 0.3, 0.5 and 0.7) kept in main plots and 4 fertility levels (0 kg N + 0 kg P_2O_5/ha, 40 kg N+ 20 kg P_2O_5/ha, 80 kg N + 30 kg P_2O_5/ha and 120 kg N + 40 kg P_2O_5/ha) in sub plots with 3 replications. The soil of the experimental field was clay loam, slightly alkaline in reaction (pH 7.6), medium in organic carbon (5.67 g/kg), medium in available nitrogen (368 kg/ha), phosphorus (23.9 kg/ha), potassium (311 kg/ha) and sulphur (16.5 kg/ha). The nitrogen was applied through urea and phosphorus through SSP as per treatment wise. Half dose of nitrogen and full dose of phosphorus were drilled in ear marked plot before sowing and remaining dose of nitrogen was given at the time of irrigation. Irrigations were applied as per treatment based on IW/CPE ratio. Irrigation dates for schedules based on IW/CPE ratio were computed based on IW= 60 mm and daily pan evaporation as cumulative pan evaporation.

RESULT AND DISCUSSION

Seed yield

Data (Table 1) revealed that Meera consistently recorded higher seed yield as compared to variety Rashmi during both the years which was registered 10.04 and 9.45 per cent in 2000-01 and 2001-02, respectively. Irrigation at IW/CPE ratio of 0.5 gave significantly higher seed yield as compared to IW/CPE ratio of 0.3 during both the years. Although the highest seed yield was recorded at IW/CPE of 0.7 but remained on par with IW/CPE of 0.5. Application of irrigation at IW/CPE of 0.7 enhanced seed yield by 2.95 & 24.29 per cent in 2000-01 and 3.44 & 27.22 per cent in 2001-02 over IW/CPE of 0.5 and 0.3, respectively.

Application of fertilizer at 80 kg N + 30 kg kg P_2O_5/ha produced significantly higher seed yield as compared to 40 kg N +20 kg P_2O_5/ha and 0 kg N+ 0 kg P_2O_5/ha during both the years. However, the highest seed yield was obtained at fertility level 120 kg N + 40 kg P_2O_5/ha but it was found statistically at par with 80 kg N + 30 kg P_2O_5/ha during both the years. Fertilizer application at 120 kg N + 40 kg P_2O_5/ha increased seed yield by 2.75, 27.15 and 103.53 % during 2000-01 and 2.85, 24.23 and 91.82 % during 2001-02 over 80 kg N + 30 kg P_2O_5/ha, 40 kg N + 20 kg P_2O_5/ha and 0 kg N + 0 kg P_2O_5/ha, respectively.

N and protein content in seed

Data (Table 1) further revealed that both the varieties did not show any significant effect on N and protein content in seed during both the years. Data on protein content indicate that there was not significant difference in protein content due to variety. The findings are in close conformity with Nimje and Gandhi (1994) and Ameta (2002) who also reported that there was no significant due to varieties.

Application of irrigation at various IW/CPE ratio had significant effect on N and protein content in seed during both the years. Irrigation at IW/CPE ratio of 0.7 gave significantly higher N and protein content in seed as compared to IW/CPE of 0.5 and 0.3 respectively. IW/CPE of 0.5 also gave significantly higher N and protein content over IW/CPE ratio of 0.3 during both the years. The N and protein content was significantly influenced by the application of various fertility levels during both the years. Application of fertilizer at 80 kg N + 30 kg P_2O_5/ha gave significantly higher N and protein content over preceding fertility levels but was found statically on par with 120 kg N + 30 kg P_2O_5/ha. The significant increase in protein content in seed of linseed could be ascribed to significant increase in N content in seed. Results corroborated the findings of Forment *et al.* (2000) in linseed.

Oil content and oil yield

A perusal of data (Table 2) revealed that variety Meera consistently recorded higher mean oil percent (42.47) and oil yield (644.03 kg/ha) as compared to variety Rashmi. It was recorded 15.2 per cent more oil yield over Rashmi. Data on oil content and production under the influence of variety indicate that there was significant increase in oil content of variety Meera over Rashmi. The increase in oil content with variety Meera could be attributed to the fact that increase in reproductive growth caused increase in seed owing to profuse growth of the plant and rise in temperature during seed developing phase. Asthana and Rai (1971) and Dubey and Sharma (1981) also reported increase in oil content in linseed.

Application of irrigation at various IW/CPE ratio had significant effect on oil content and oil yield during both the years. Irrigation at IW/CPE ratio of 0.5 gave significantly higher oil content and oil yield as compared to IW/CPE ratio 0.3 during both the years. Though the highest oil content and oil yield was recorded at IW/CPE ratio of 0.7 but it was found statistically at par with IW/CPE of 0.5. Irrigation at IW/CPE 0.7 recorded 4.47 and 36.19 % higher oil yield over IW/CPE of 0.5 and 0.3, respectively. The result showed that each increment in irrigation level significantly increased oil content and production by linseed crop. The increase in oil content might be due to reduced irrigation intervals and enhancing the carbohydrate accumulation. Further oil production which is a function of seed yield and oil content in seed recorded increase with increasing levels of irrigation. The results are in conformity with Alessi and Power (1970).

The oil content and oil yield was significantly increased by the application of various fertility levels during both the years. Application of fertilizer at 80 kg N + 30 kg P_2O_5/ha produced more oil content and

oil yield as compared to 40 kg N +20 kg P_2O_5/ha and 0 kg N + 0 kg P_2O_5/ha during both the years. However, the highest oil content and oil yield was recorded with the fertility levels of 120 kg N + 40 kg P_2O_5/ha but it was found statistically at par with 80 kg N+30 kg P_2O_5/ha during both the years. Among fertility levels, application of 120 kg N + 40 kg P_2O_5/ha produced 3.98, 31.88 and 124.30 % more oil yield over the preceding levels of fertility, respectively. The significant increase in oil production under nitrogen and phosphorus fertilization up to 80 kg N + 30 kg P_2O_5/ha could be ascribe to significant increase in seed yield and also marginal increase in oil content of seed. The significant increase in protein content in seed of linseed could be ascribed to significant increase in N content in seed. Findings of Forment *et al*. (2000) in linseed crop also corroborated the results of present investigation and conform the increasing trends of oil production and protein content due to increasing rates of N and P fertilization.

Table 1. Effect of varieties, irrigation schedules and fertility levels on nitrogen content in seed and seed yield

Treatment	Seed yield (q/ha)			Nitrogen content (%)			Protein content (%)		
	2000-01	2001-02	Mean	2000-01	2001-02	Mean	2000-01	2001-02	Mean
Varieties									
Meera	15.23	15.55	15.39	1.84	1.84	1.84	11.48	11.52	11.50
Rashmi	13.84	14.21	14.03	1.84	1.85	1.84	11.52	11.55	11.53
SEm±	0.20	0.24	-	0.012	0.010	-	0.08	0.06	-
CD (P=0.05)	0.63	0.75	-	0.039	0.032	-	NS	NS	-
IW/CPE ratio									
0.3	12.64	12.75	12.69	1.73	1.73	1.73	10.80	10.84	10.82
0.5	15.26	15.68	15.47	1.87	1.88	1.87	11.71	11.78	11.74
0.7	15.71	16.22	15.97	1.92	1.92	1.92	11.98	11.98	11.98
SEm±	0.25	0.29	-	0.015	0.012	-	0.09	0.07	-
CD (P=0.05)	0.77	0.92	-	0.048	0.039	-	0.30	0.24	-
Fertility levels									
0+0	8.79	9.41	9.10	1.73	1.78	1.78	11.11	11.15	11.13
40+20	14.07	14.53	14.30	1.82	1.83	1.82	11.40	11.44	11.42
80+30	17.41	17.55	17.48	1.87	1.87	1.87	11.68	11.70	11.69
120+40	17.89	18.05	17.97	1.89	1.89	1.89	1.80	11.84	11.82
SEm±	0.26	0.30	-	0.015	0.011	-	0.09	0.06	-
CD (P=0.05)	0.75	0.85	-	0.045	0.032	-	0.28	0.19	-

Table 2. Effect of verieties, irrigation schedules and fertility levels on oil content in oil content and oil yield of linseed

Treatments	Oil content (%)			Oil yield(kg/ha)		
	2000-01	2001-02	Mean	2000-01	2001-02	Mean
Varieties						
Meera	42.07	42.87	42.47	651.01	677.06	644.03
Rashmi	39.93	41.04	40.48	561.31	591.46	576.38
SEm±	0.57	0.49	-	13.33	13.71	-
CD(P=0.05)	1.80	1.56	-	42.01	43.19	-
IW/CPE ratio						
0.3	38.98	39.99	39.48	499.50	515.64	507.57
0.5	41.71	42.67	42.19	645.74	677.80	661.77
0.7	42.31	43.2	42.76	673.25	709.34	691.29
SEm±	0.70	0.61	-	16.33	16.79	-
CD (p=0.05)	2.20	1.91	-	51.45	52.90	-
Fertility levels						
0+0	37.72	38.73	38.22	333.12	365.63	349.37
40+20	40.91	41.87	41.39	578.15	610.24	594.19
80+30	42.41	43.37	42.89	741.63	765.57	753.60

120+40	42.96	43.86	43.41	711.74	795.59	783.66
SEm±	0.51	0.50	-	12.50	15.49	-
CD(P=0.05)	1.46	1.44	-	35.85	44.44	-

CONCLUSION

The two years results inferred that there was significant improvement in yield and quality parameters (oil and protein content) of Meera linseed variety along with irrigation schedule at IW/CPE of 0.5 and fertility level of 80 kg N + 30 kg P_2O_5/ha.

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