Environment & Ecology (4) : 1879—1882, 2011
 ISSN 0970-0420

Response of Irrigation Scheduling and Sulfur Fertilization on Growth, Yield and Oil Content of Gobi Sarson

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Abstract

A field experiment conducted during *rabi* of 2005-06 and 2006-07 at Jammu to study the effect of irrigation scheduling on growth, yield and oil content of gobi sarson. The highest seed yield and oil content and oil yield was obtained by the application of three irrigations, one each at branching, flowering and seed development. On an average there was 8.59 q/ha increase in seed yield and 172.5% increase in oil content over no irrigation/rainfed conditions, the gap narrowing to 5.18 q/ha and 2.25 q/ha when one and two irrigations were applied at flowering and flowering and seed development stage respectively with the consequent increase of oil content to 123 and 67% over no irrigation/rainfed conditions. The crop responded to sulfur application up to 80 kg/ha but the application of 40 kg/ha sulfur was statistically at par with higher levels of sulfur in terms of growth attributes, seed yield and oil content.
Key words : Irrigation scheduling, Yield, Oil content, Oil yield.

Brassica oilseed is an important *rabi* crop of J % K state, grown in an area of 63,270 hectares with production of 535,000 q with the productivity of 8.45 q/ha in 2007-08 (1). The productivity is low compared to the potential yield of 25—30 q/ha of improved *Brassica* species like gobi sarson. Gobi sarson is mostly grown in water constraint areas and on marginal lands with poor fertility status resulting in low yields. Optimum scheduling of irrigation and fertilization assume significance in efficient use of limited water and fertilizers for higher yields. *Brassica* sown after heavy presowing irrigation produced maximum seed yield, with one irrigation 21 days after sowing (DAS) which gives 30—40% higher yield than with no post sowing irrigation (2). However, the first irrigation could be delayed up to 25—35 DAS (3), which helps the plant to branch well resulting in profuse flowering and fruiting. If irrigation is applied at flowering, it could lead to increase in yield by 26% compared to 9% increase with irrigation at pod formation stage (4). Apart from irrigation, yield of oilseed crops can be increased through fertilization particularly nitrogen and sulfur. Prasad et al. (5) reported the beneficial effect of nitrogen and sulfur on seed and oil yield. Reports from elsewhere also reveal response of *Brassica* in respect of seed and oil yield to nitrogen and sulfur (6, 7). The present investigation was therefore conducted to find the irrigation schedule and doses of sulfur for gobi sarson and its effect on its productivity.

Methods

A field experiment was conducted on gobi sarson during *rabi* of 2004-05 and 2005-06 at WMRC, experimental block of SKUAST-J. The soil was sandy loam, low in N (216 kg/ha) and medium in P (13.60 kg/ha), K (156.3 kg/ha) and S (11 ppm) with pH 7.1. The experiment was laid out in split plot design with three replications, the main plot comprising of four levels of irrigations (no irrigation or rainfed, one irrigation at flowering, two irrigations, one each at flowering and seed development and three irrigations, one each at branching, flowering and seed development) and subplots comprising five levels of sulfur (0, 20, 40, 60 and 80 kg/ha). The crop was fertilized with 60 kg N, 40 kg P_2O_5 and 20 kg K_2O/ha applied through urea DAP and MOP whereas test variety was DGS-I during both the years of experimentation. Entire amount of P_2O_5 and K_2O and one-half of N was applied as basal and the remaining half of N during branching except in no irrigation or rainfed treatment where two-third N along with full amount of P_2O_5 and K_2O was applied as basal and remaining one-third N applied after 30 days after sowing. The sulfur was applied through gypsum and

Table 1. Effect of irrigation scheduling and sulfur fertilization on growth attributes of gobi sarson.

Treatments	Plant height (cm)		Primary branches/ plant		Secondary branches/ plant		Siliqua/plant		Length of siliqua (cm)		Seeds/siliqua	
	2005-06	2006-07	2005-06	2006-07	2005-06	2006-07	2005-06	2006-07	2005-06	2006-07	2005-06	2006-07
Irrigation Regimes												
Rainfed	122.0	122.8	7.2	6.7	3.5	4.1	112.0	111.5	4.4	4.57	7.78	7.73
Flowering	143.9	145.3	13.3	12.7	5.6	5.8	207.5	208.6	5.37	5.08	11.54	11.43
Flowering + seed development	151.5	153.7	15.2	14.9	7.1	7.2	243.9	241.7	5.96	5.67	12.93	12.91
Branching+flowering +seed development	157.1	157.9	15.7	15.5	7.3	7.4	257.0	253.3	6.32	6.04	14.06	13.92
CD (5%)	6.9	7.3	1.5	1.2	1.4	1.3	12.1	9.5	0.35	0.36	1.12	0.96
Sulfur Levels (kg/ha)												
0	139.4	139.8	12.4	11.3	4.9	4.5	140.6	140.3	4.74	4.51	7.39	7.39
20	141.7	142.6	13.0	12.9	5.6	5.7	210.7	210.2	5.31	5.26	11.11	10.97
40	143.5	143.9	13.4	13.2	5.7	5.9	222.1	218.4	5.68	5.59	12.29	12.33
60	144.7	145.1	13.9	13.7	5.9	6.1	227.9	228.0	5.89	5.76	12.92	12.88
80	145.3	145.4	14.5	14.0	6.1	6.2	230.8	31.5	6.00	590	13.41	13.40
CD (5%)	1.8	1.6	1.3	1.4	0.9	0.7	11.7	8.7	0.30	0.24	0.80	0.25

was applied as basal before sowing. For irrigation schedule, a uniform depth of water (6 cm) was applied by Parshall Flume with the throat width of 7.5 cm.

Plants were randomly selected from each plot, uprooted, sun and oven dried. N content of plant and seed was determined by Kjeldhals method, P by Oleson's method (8), potassium by flame photometer (9) and sulfur content by turbidemetric method (10). The oil content of seed was determined by Nuclear Magnetic Resonance (NMR) Spectroscope New port Aalyzer Model MK 11(A) employing non-destructive method of oil estimation.

Results and Discussion

Irrigation Regimes

Plant height, primary branches, and secondary branches, siliqua/plant, length of siliqua and seed/siliqua increased significantly with increasing number of irrigations over no irrigation or rainfed condition during both the years of experimentations (Table 1). Higher values of growth parameters were recorded when gobi sarson was irrigated three times, one each at branching, flowering and seed development which were significantly superior over no irrigation or over one irrigation at flowering except siliqua/plant, length of siliqua and seed/siliqua where it was statistically superior over two irrigations, one each at flowering and seed development during both the years of experimentation. Under no irrigation or rainfed condition the growth attributes were reduced during both the years. This could be due to increase in soil strength, decreased root growth and proliferation, thereby decreasing the absorption of nutrients leading to poor growth (11).

Similarly, irrigation levels significantly influenced 1,000 seed weight, seed and stover yield, oil content and oil yield during both the years of experimentation (Table 2). Application of irrigation at branching, flowering and seed development recorded significantly more value than two, one or no irrigation producing 14.25 and 13.89 q/ha seed yield, 44.60 and 41.94 q/ha Stover yield, 39.00 and 38.57% oil content and 5.55 and 5.35 q/ha oil yield during *rabi* of 2005-06 and *rabi* 2006-07 respectively. On an average, irrigating gobi sarson thrice at branching, flowering and seed development yielded 8.59 q/ha more seed yield than no irrigation, 5.18 q/ha over one irrigation at flowering and 2.25 q/ha when irrigated twice at flowering and seed development. During both the years, oil content in seed and oil yield was statistically superior over no irrigation and one irrigation at flowering with three irrigations at branching, flowering and seed development recording higher values but being at par with

Table 2. Effect of irrigation scheduling and sulfur fertilization on 1000-seed weight, seed yield, oil content and oil yield of gobi sarson.

Treatments	1000 seed weight (g)		Seed yield (q/ha)		Stover yield (q/ha)		Oil content in seed (%)		Oil yield (q/ha)	
	2005-06	2006-07	2005-06	2006-07	2005-06	2006-07	2005-06	2006-07	2005-06	2006-07
Irrigation Regimes										
Rainfed	3.02	3.17	5.59	5.37	23.25	18.95	37.20	36.11	2.07	1.93
Flowering	3.31	3.46	8.96	8.83	27.77	26.04	37.56	36.50	3.36	3.32
Flowering + seed development	3.63	3.60	12.33	11.31	31.31	28.04	38.09	37.44	4.69	4.23
Branching + flowering+seed development	3.98	3.74	14.25	13.89	44.60	41.94	39.0	38.57	5.55	5.35
CD (5%)	0.28	0.13	1.55	0.96	0.84	1.02	1.18	1.13	0.56	0.36
Sulfur Levels (kg/ha)										
0	3.10	3.18	7.22	7.02	22.01	21.90	36.63	36.08	2.64	2.53
20	3.42	3.39	9.94	9.44	27.42	28.53	37.65	36.44	3.74	3.43
40	3.60	3.51	11.35	10.57	33.84	29.45	38.28	37.20	4.34	3.93
60	3.68	3.62	11.42	10.95	37.82	31.75	38.49	37.52	4.39	4.10
80	3.74	3.69	11.48	11.17	38.14	32.61	38.60	37.82	4.43	4.22
CD (5%)	0.31	0.30	0.26	0.39	1.16	1.52	0.58	0.34	0.12	0.21

two irrigations at flowering and seed development. On an average irrigating gobi sarson three times at branching, flowering and seed development, two times at flowering and seed development and once at flowering increased oil yield by 172.5, 123 and 67% over no irrigation respectively. This could be due to better lipid synthesis with optimum moisture supply. Panda et al. (12) reported similar results.

Sulfur Fertilization

Application of sulfur significantly increased all the growth attributes of gobi sarson with increasing the levels of sulfur during both the years of experimentation (Table 1). Application of 80 kg/ha of sulfur recorded the higher yield attributes which were statistically at par with 40 and 60 kg/ha sulfur except length of siliqua and seed/siliqua in both the years where 80 kg/ha sulfur was statistically at par with 60 kg/ha sulfur and superior to other levels of sulfur. Improvement in growth attributes could partly be attributed to the beneficial effect of sulfur fertilization as the nutrient plays an important role in various metabolic processes in plant (13). Bagat and Soni (14) and Chaudhary et al. (15) also reported beneficial effects of sulfur fertilization.

Increasing sulfur levels had also beneficial effect on 1,000-seed weight, seed and stover yield, oil content and oil yield in increasing their value over control (Table 2). During both the years of experimentation seed yield, oil content and oil yield increased significantly up to 40 kg/ha except 1,000-seed weight where it was significant up to 20 kg/ha. Further, increase in sulfur dose from 60 to 80 kg/ha though improved their values, but their effect was non significant. On an average there was 35.59, 53.18, 64.48 and 58.17% increase in yield over control (no sulfur) by applying 20, 40, 60 and 80 kg/ha sulfur with corresponding increase in oil content by 0.69, 1.39, 1.65 and 1.86% and increase in oil yield by 1.0, 1.55, 1.66 and 1.70 q/ha over no sulfur fertilization respectively. Higher oil yield with higher sulfur dose was due to higher seed yield. Application of sulfur to plant enhanced the formation of acetyl coenzyme A, a precursor compound for the synthesis of long chain of fatty acid resulting in increase in oil content which ultimately led to greater oil yield (13). This is in conformity with the findings of Bagat and Soni (14) and

Panda et al. (12).

Thus it could be concluded that yield of gobi sarson could be augmented by irrigating crop thrice, one each at branching, flowering and seed development. But, it seems that flowering and seed development stage is important for obtaining higher yields of gobi sarson under limited water supply. However, one irrigation at flowering stage might be recommended for getting higher yields under deficit irrigation conditions. Application of 40 kg/ha of sulfur increased yield over no sulfur in addition to recommended N, P and K.

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