

Winter type rapeseed varieties performance under rain-fed and irrigation in mid-west cold areas of Iran

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Abstract

Brassica napus L. (Canola) has been recently introduced as commercial crop mostly under irrigation in Iran. More than 60% of the cultivated area in the country is rain fed, it is important to expand it in rain fed regions. This study was conducted for two years 2000 to 2002, to assess potential of 20 winter type varieties, which were from Denmark (7), France (2), Germany (2), Iran (1) Netherlands (4) and Sweden (4), trials were conducted under rain fed and irrigation at two stations located near Sararood and Islamabad towns in the mid-west region of Iran. Sowing the first year was done on 15 October at Sararood with first effective rain. Sowing under irrigation was in the middle of September at Islamabad, irrigated five times up to maturity. Both sites had 90-100 frost days in season. When the low temperature started occurring the crop was in rosette stage at both the locations. The second year rain was late by 45 days; the crop at Sararood germinated and was soon caught in low temperatures and frequent frost killing all the varieties. The irrigated crop remained unaffected by low temperature being in rosette in cold period. The 20 varieties average yield at Sararood the first year was 1193 kg/ha, yield of Denmark varieties varied 800 (Hopper) to 1552 kg/ha (Aviso); yield of two France varieties was 854 kg/ha (PAU-C61) and 1052 (Colvert); Germany's varieties yield was 746 (Fornex) to 940 kg/ha (Orient); Iran variety yielded 1444 kg/ha; Netherlands varieties yielded 1043 (Consul) to 1651 kg/ha (Parade); the yield of Sweden varieties was 1108 (Kvintel) to 1449 kg/ha (Opera). The two-year average yield under irrigation at Islamabad was 3896kg/ha. Yield range was 3035 (Kvintel) to 4774kg/ha (Parade). Other characters that were measured are pods/plant, seeds/plant, 1000-seed-weight, plant height, days to maturity, days to flowering and flowering duration. Varieties matured under irrigation in 241 to 251 days, under rain from 215 to 221 days. There is no difference between average temperature of the two locations and the number of frost days of locations. There is 26 to 30 days delay in maturity under irrigation. The lesson learned from these tests is that planting in rain fed cold areas should be made at a time when the crop can reach rosette stage by time low temperatures start occurring. At Sararood the average effective rain falling time is 2nd of November, if rain is delayed the sowing by that time should be with initial irrigation, if irrigation is not available some cold tolerant crop like wheat may be planted. According to long time climatic data 82 % of the time colza can be planted with rain to produce economical yield.

Key words: Iran, winter type, rapeseed, dry land, irrigated.

Introduction

Collectively, oilseed crops and their products are the second most valuable commodity moving in the world trade. Technological advances have led to higher production levels and improvements in product quality and versatility (Downey *et al.* 1989). Human derives their energy from the three major sources, protein, fat and carbohydrate. Of these energy sources, fat has the highest available energy density, 9 kcal/g as compared with 4 kcal/g for each of protein and carbohydrate (Vles and Gothenbos 1989), thus fats and oil are the major source of energy. Per capita consumption of fats/oils in many developing countries, which includes almost all of West Asia North African region (Beg 1994), is well below that of recommended quantities for adequate nutrition. Iran is short of edible oil. Around a million ton of this commodity is imported annually for local consumption. The local edible oil production could hardly meet 20 % of the requirement (Beg 1995). It was therefore thought prudent to introduce oil crop *Brassicas* in the country for fall sowing in irrigated and rain fed areas. In rain fed region almost sixty percent of the cultivated land (Sadri and Banai 1996) remain fallow annually which can be shared by this new crop. Preliminary test showed that the crop has a promise, thus first commercial crop, about 30,000 ha, was planted in 1999 under irrigation, mostly in warm area, under supervision of Agriculture Department. Two winter type varieties, Cobra and Ceres and a spring type PF variety, all three from Germany, were planted on this area under irrigation in mild cold and warm areas. Trials reported in this paper were conducted to find out, *inter alia*, suitable varieties for mid-west mild cold areas of the country, and to assess potential of the varieties under rain fed and irrigated conditions.

Materials and Methods

The experiments were conducted in 2000-01 and 2001-02 at two experimental stations located in the mid-west region of Iran in Zagross mountain range valley. Dry Land Agricultural Research Station Sararood is meant for research on crops under rain fed conditions. The soil is deep alluvial with sandy loam texture and moderately high water storage capacity, soil has a PH of 7.4. The soil and other environment at Islamabad which is located 80 Km west of Sararood is almost similar, at Islamabad water is available for irrigation and research mostly is under irrigation.

Weather

The climate at both the stations is Mediterranean with relatively short mild cold winter, temperatures are high in summer.

Rainfall mostly fall between October and May, with some years little rain in September. The average annual temperature at Sararood is 13.8 °C and at Islamabad 10.5 °C. Annual frost days at first location are 90 and at second 100 days. Absolute low temperature at first station for the two years was -11.2 and -9.4 °C, for the second station was -21.8 and 20.4 °C. Rain during the two test years was 420 and 360 mm at Sararood and 360 and 380 mm at Islamabad. Average annual evaporation at the two stations is 2195 mm and 1808 mm.

Varieties

Nineteen imported and a local variety was included in the trials. Varieties were, seven from Denisco Denmark (Aviso, Bellini, Herald, Hopper, Modena, Ryder, Turner); four from SW-Sweden (Kvintel, Opera, Pastell, SW-0756) four from Netherlands (VDH 8003-98, Akamar, Consul, Parade), two from Germany (Orient, Fornex) two from France (PAU-C61 and Colvert) and one from Iran (a selection from a cross of Regent X Cobra). The varieties are mostly commercial in the countries of origin.

Procedure

The trials were laid out in a randomized block design with four replications at Sararood and three at the second station. At Sararood plots were 12 m long, 6 rows 30 cm apart, sowing was with small plot power driven planter on flat land. At Islamabad sowing was on ridges, plot length was 6 m, 5 ridges 30 cm apart. Plots were irrigated after sowing. Observations recorded on crop before harvest was pods per plant (5 plants/plot), seeds per pod (10 pods per plant) and plant height. Yield was recorded from the 4 central rows both end trimmed at Sararood and 3 central ridges at Islamabad. 1000-seed-wt was recorded from well mixed seed of each plot.

Plantings were made on fallow land both the years at both the stations, land was prepared before the start of rainy season, 60 kg nitrogen and 50 kg p2o5 was applied at land preparation. Sowing at Sararood both the years was middle of October, few days before the average effective rain date. At Sararood effective rain 11 mm first year came just after sowing, though rain has started by 4th of October but was not sufficient to wet the soil. The second year effective rain occurred 45 days late than usual, on 30th November, which germinated and emerged the crop, but crop could not reach the rosette stage when severe low temperatures damaged the small seedlings. At Islamabad sowing was made each year by 15th September with irrigation, three irrigation 40 mm each were applied before rains started, and three irrigations were applied, each at 50 % flowering, at flower completion and at full pod formation. Experiments were kept weed free by manual weeding.

Table 1. Rapeseed performance under rain fed conditions in cold region at Sararood, Kermanshah, Iran. 2000-01

Varieties	Pod/ Plant	Seeds/ Pod	1000 Seed Wt	Plant Height	Yield Kg/ha
Parade	103	19	4.4	140	1651
Aviso	86	19	3.7	113	1552
Modena	87	17	4.1	131	1473
Opera	105	20	4.1	133	1449
Hopper	79	18	3.7	129	800
Reg*Cob	83	20	4.9	148	1444
Ryder	83	21	4.0	137	1411
Herald	104	19	4.0	126	1371
Orient	78	17	4.8	126	940
VDH	88	22	3.9	131	1325
Pastell	80	17	4.6	121	1300
Bellini	91	18	3.5	125	1029
Consul	89	22	4.0	132	1043
Akamar	92	19	3.8	129	1081
Turner	73	17	4.0	126	1065
Kvintel	78	18	3.5	122	1108
SW0756	107	19	3.4	135	1171
Colvert	84	18	5.0	119	1052
Fomax	76	17	4.6	122	746
PAU-C61	92	20	3.5	126	854
Average	88	19	4.0	128	1193

Results and discussion

Temperature effects.

First year at Sararood crop was in well rosette stage when low temperature up to -11.2 °C occurred. The Second year rains were late and low temperatures were early by 15 days which killed the young seedlings of all the varieties to the extent that evaluation of the varieties was not possible. At Islamabad, at low temperatures by end of November, both the years, crop was in a strong rosette stage, only the lower leaves of the rosette of all the varieties were damaged.

Yields

The yield and other agronomic characters of varieties at the two stations under rain fed and irrigation conditions are given below in Table 1 and Table 2. Observations show that variety Parade has out yielded at both the stations. The yield of Parade on dry land was 1651 kg/ha (Table 1) and average yield under irrigation was 4774 kg/ha (Table 2). The second and 3rd variety in yield on dry land was Aviso (1552 kg/ha) and Modena (1473 kg/ha). There are three varieties Opera, Reg*Cobra and Ryder which produced more than 1400 kg/ha each, these yields are comparable with the world average yield of 1451 kg/ha (FAO 1997), USA, 1468 kg/ha, and China, 1405 kg/ha, while more than the yields obtained in Canada, 1288 kg/ha and India, 1022 kg/ha (FAO 1997).

The observations obtained on varieties at irrigated station are given in Table 2. Average yield of 20 varieties is 3896 kg/ha, the yields of all the varieties are comparatively higher than on dry land. Varieties Parade, Orient and Consul have produced the highest yields of 4774, 4524 and 4273 kg/ha, these yields and yields from other 17 varieties are much better than higher yields obtained in Germany (3096 kg/ha) and France (3526 kg/ha) as reported by FAO 1997.

Table 2. Rapeseed performance under irrigation in cold region at Islamabad, 2000-01 and 2001-02.

Varieties	2001-02					2000-01					Two Yrs Aver
	Pod/Pl	Seed/ Pod	1000.s. wt (g)	Pl. Height	Yield/kg	Pod/Pl	Seed/pod	1000 s.wt	Pl Height	Yield/ Kg	
Parade	125	24	3.2	140	4333	124	23	3.3	154	5216	4774
Aviso	168	24	3.3	161	3655	141	21	3.4	139	3759	3707
Modena	167	26	3.4	168	3927	108	24	3.6	135	4291	4109
Opera	153	28	3.3	155	3548	120	22	3.5	153	3837	3692
Hopper	164	24	3.3	164	3459	116	23	3.7	149	3577	3518
RegxCob	139	27	3.3	150	3710	115	22	3.7	140	3192	3451
Ryder	149	23	3.8	169	3708	118	21	4.0	147	3436	3572
Herald	125	24	3.7	158	3284	138	25	3.5	148	3204	3244
Orient	150	25	3.8	130	4079	163	21	3.2	146	4970	4524
VDH	112	25	3.4	121	4023	114	21	3.8	154	4460	4241
Pastel	149	28	3.4	163	4083	99	24	3.0	143	4039	4061
Bellini	147	26	3.2	147	3848	133	23	3.7	145	3932	3890
Consul	127	27	3.4	153	3993	128	20	4.0	160	4554	4273
Akamar	135	26	3.5	148	3636	134	19	3.9	137	4477	4056
Tumer	129	24	3.3	142	4034	135	26	3.2	150	3879	3956
Kvintel	165	23	3.3	157	3165	141	21	3.2	150	2905	3035
SW0756	155	28	3.3	163	3990	91	23	3.8	132	4057	4023
Colvert	133	25	3.5	140	3313	134	20	3.5	140	3847	3580
Fornax	128	23	3.7	130	3538	128	21	3.3	139	4396	3967
PAU-C61	129	24	3.3	142	4034	113	22	3.9	142	4436	4235
Average	142	25	3.4	150	3768	125	22	3.6	145	4023	3896

Table 3. Yield comparison of varieties of different origin

Country	Varieties	Average Yield kg/ha		Yield range in kg/ha
		Rainfed	Irrigated	
Denmark	7	1243	3713	Rainfed: 800 (Hopper)-1552 (Aviso) Irrigated: 3244 (Herald)-4109 (Modena)
Sweden	4	1257	3702	Rainfed: 1108 (Kvintel)- 1440 (Opera) Irrigated: 3035 (Kvintel)- 4023 (SW-0756)
N.land	4	1275	4336	Rainfed: 1043 (Consul)- 1651 (Parade) Irrigated: 4056 (Akamar)- 4774 (Parade)
France	2	952	3907	Rainfed: 854 (PAU-C61)- 1052 (Colvert) Irrigated: 3582 (Colvert)- 4235 (PAU-C61)
Germany	2	843	4245	Rainfed: 746 (Fornax)- 940 (Orient) Irrigated: 3967 (Fornax)- 4524 (Orient)
Iran	1	1444	3451	-

Other agronomic characters.

Yield and other agronomic characters of varieties are given in Table 3 for comparison. Average yield of four varieties from Netherlands in dryland was 1275 kg/ha with a range of 1043 (Consul) to 1651 kg/ha (Parade), under irrigation the average yield was 4336 kg/ha with a range of 4056 (Akamar) to 4774 Kg/ha (Parade). The high yields exhibit the effects of several irrigations on varieties to express their potential. The dry land average yield of seven Denisco Denmark varieties was 1243 kg/ha with a range of 800 kg/ha (Hopper) to 1552 kg/ha (Aviso), without Hopper average yield jump to 1316 kg/ha for six varieties. The good yields show the importance of Denmark varieties for mild cold dry lands of Iran. The irrigated average yield of these seven varieties was 3713 kg/ha with a range of 3244 kg/ha (Herald) to 4109 kg /ha (Modena). The dry land

average yield for four Sweden varieties was 1257 kg/ha with a range of 1108 kg/ha (Kvintel) to 1449 kg/ha (Opera); under irrigation the average yield was 3702 kg/ha with a range of 3035 kg/ha (Kvintel) to 4023 kg/ha SW-0756). The dry land yield of two France varieties was 1052 kg/ha for Colvert and 854 kg/ha for PAU-C61, yield under irrigation was 3580 kg for Colvert and 4235 kg/ha for PAU-C61. Two Germany varieties in dry land yielded 940 kg/ha (Orient) and 746 kg/ha (Fornex), irrigated yield was 4524 kg/ha (Orient) and 3967 kg/ha (Fornex). One local Iran variety has produced encouraging yield of 1444 kg/ha on dry land and 3451 kg/ha under irrigation, this variety can replace import of seed to some extent for some time.

The yield components like pods/plant, seeds per pod, and plant height of varieties in dry land trials were considerably less than crops raised under irrigation, however 1000-seed-weight was unbelievably greater in rain fed crop.

Pods per plant: The average pods/plant in dry-land were 88, while average of two years in irrigated crop was 133, which is 52 % more than rain-fed crop. Pod per plant have a good correlation with yield and can help in selection of promising varieties (Downey and Rimmer 1993).

Number of seeds per pod: The average seed/pod in rain-fed crop was 19 and in irrigated crop was 24, 26 % more than rain-fed crop.

1000 seed weight: Average 1000-seed-weight in dry-land crop was 4 gram and in irrigated crop was 3.5 g, which is 14 % less than rain-fed crop, less seed in a pod increased the seed wt in dry-land crop.

Plant height in cm: Average plant height of rain-fed crop was 128 cm while that of irrigated crop was 148 cm, 16 % taller than rain-fed crop.

Conclusion

1. Table 3 show that relatively north European varieties are suitable for rain-fed mild cold region, while varieties from all the tested countries are suitable under irrigation.

2. One Iranian bred variety 'Regent x Cobra' has produced comparatively good yield both on dry-land and under irrigation. This variety can be increased for commercial purpose to safe on import of seed for both rain-fed and irrigated condition in mild cold area.

3. Sowing date is very important in rain-fed cold areas. Sowing should be made by average effective rain date, if it is by end of October, and low temperatures are a month away.

4. In rosette stage winter type colza can withstand low temperatures up to -22°C for short period of time without economic cold damage.

5. Farmers having tube well in rain-fed areas can always plant colza, with rain if it is in time or with one initial irrigation if rain is late. This arrangement will produce economically acceptable crop.

6. Cold tolerant selected varieties like Parade, Aviso, Modena or Reg*Cobra can be used in mild cold rain-fed areas.

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