International Journal of Plant & Soil Science

34(22): 1006-1011, 2022; Article no.IJPSS.90257
ISSN: 2320-7035

Effect of Salinity on Growth and Yield of Barley

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2022/v34i2231461

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/90257

Original Research Article

Received 12 June 2022
Accepted 16 August 2022
Published 25 August 2022

ABSTRACT

The present study was conducted during season of 2017-2018 at Agricultural Research Farm, School of Agriculture, Suresh Gyan Vihar University, Jagatpura, Jaipur, India. To assess individual performance in saline water conditions, ten barley cultivars were produced in the field: RD 2715, RD 2035, RD 2592, RD 2849, RD 2860, RD 2552, RD 2668, RD 2097, BH 946, RD 2052. According to the findings, out of the ten cultivars, RD 2552 considerably recorded the highest plant population, growth characteristics, and ultimately increased grain(45.21 q ha^{-1}) as well as straw yield of barley.

Keywords: Cultivars; RD; BH; saline water; growth; yield.

1. INTRODUCTION

"Barley (*Hordeum vulgare* L) member of grasses family, it is a self pollinated, diploid species with 14 chromosome number. Each 100 g of barley grain comprises 10.6 g protein, 2.1 g fat, 64.0 g carbohydrate, 50.0 mg calcium, 6.0 mg iron, 31 mg vitamin B1, 0.10 mg vitamin B_2 and 50 µg folate" (Vaughan et al. 2006). Barley that is high in protein is ideal for animal feed. Malting barley typically contains less protein. After maize, rice, and wheat, barley is the fourth-largest cereal crop, producing 132 million tonnes yearly. "In India, barley was cultivated on 0.66 m ha^{-1} area during 2015-16 with 1.62 million tonnes of production at an average productivity status of 24.7q ha^{-1} [1] Rajasthan, it is have the first position with area 0.223 million ha^{-1} and

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production of 0.620 million tonnes with productivity of 2,774 kg ha^{-1}. This production is far below that of most of the states like Haryana (0.137million tonnes), Punjab (0.047 million ton) and Jammu and Kashmir (0.008 million ton). Barley production can be improved by increasing either the area under cultivation or the yield per unit area" [2].

Barley can withstand saline water and sodic soil. Salinity is the concentration of dissolved salts in water or soil and is expressed in terms of concentration (mg L^{-1}) or electrical conductivity (dS m^{-1}). According to Grewal (2010) "salinity is one of the major a biotic environmental stresses affecting agricultural productivity". "Salinity affects many morphological, physiological and biochemical processes, including seed germination, plant growth, water and nutrient uptake" (Musyimi et al. 2007). The screening parameters that are frequently used to choose the salt tolerance genotype include seed germination and seedling growth in a saline environment. It is possible to increase these crops' irrigation-based productivity [3-13]. However, high-quality water for agricultural purposes is quickly turning into a luxury in a semi-arid nation like India. Water quality in irrigational areas is frequently poor during the drier months of the year when these crops are cultivated, and high Electrical Conductivities (ECs) due to salinity may become an issue [14].

2. MATERIALS AND METHODS

The field study was carried out at Agriculture Research farm, School of Agriculture, Suresh Gyan Vihar University, Jagatpura, Jaipur, Rajasthan. Jaipur is situated in the eastern boundary of Thar Desert a semi arid land of Rajasthan at 26.9^0 North latitude and 75.7^0 East longitude at an altitude of 1417 meter from mean sea level. Its subtropical climate features cold, dry winters and hot, dry summers. Jaipur is located in the "Semi Arid Eastern Plains" agro climatic zone and the traditionally characterized as the wheat, pulse & oil seeds crop zone of Rajasthan. The average maximum temperature during the month of May-June varies between 35.7^0C to 42.1^0C, while the average minimum temperature varies between 8.2^0C to 10.6^0C during December-January, which is the coldest month of the year. The region has 500 to 700 mm of rain on average a year, with the majority falling between July and August and 80 to 100 mm in September [15-24].

The average humidity of the tract is about 65 per cent. The soil at the location is sandy loam, Organic carbon % (0.15), Available Nitrogen (kg ha^{-1}) 250.6, Available P_2O_5 (kg ha^{-1}) 25, Available K_2O (kg ha^{-1}) 162, Electrical Conductivity (dS m^{-1} at 25^0C) 0.24, Soil pH 8.2.

The experiment was designed using Randomized Block Design, with 10 treatments reproduced three times. The treatments included 30 FIRB (furrow irrigated raised bed) techniques. Number of spike meter $^{-1}$ row length, length of spike (cm),number of grain $spike^{-1}$, test weight, grain yield (q ha^{-1}), straw yield (q ha^{-1}), harvest index (%) were recorded at harvest. To determine which of the 10 combinations under consideration was the most profitable, the economics of barley—gross return, net return, and B: C ratio—were also assessed [25-30].

3. RESULTS AND DISCUSSION

3.1 Plant Population

Data pertaining to the plant population at 20 DAS and at harvest was influenced by saline water and cultivar are presented in Table 1. Revealed that saline water did not showed significant effect on plant population at 20 DAS. Whereas, significantly maximum plant population (52.91) was observed under the cultivar RD 2552 at harvest, respectively. Significantly minimum plant population (38.49) was recorded under cultivar RD 2052 which was at par with RD 2097 cultivar. The highest plant population at harvesting stage significantly showed in the cultivar RD 2552 whereas significantly lowest plant population at harvest recorded under the cultivar RD 2097.

3.2 Plant Height (cm)

Observation on plant height as affected by different treatments were recorded at 30, 60 DAS and at harvest. Table 2. Among all the treatments significantly maximum plant height 28.4, 82.9 and 100.37 cm observed under the cultivar RD 2552 at 30, 60 DAS and harvest. It remained at pat with RD 2052 at 30 DAS and at harvest.

3.3 Days to 50 Per Cent Heading

The perusal of data in Table 3 Days to 50 percent heading was 4 and 5 days earlier in the cultivar RD 2592 and BH 946 as compared to other cultivars. At the same time days to 50 per cent heading was 19 days late in cultivar RD

2552, followed by other cultivars. Days to 50 per cent heading was 4 and 5 days early in cultivar RD 2592 and BH 946 compared to other cultivars. At the same time days to 50 per cent heading was 19 days late in cultivar RD 2552, respectively.

3.4 Days to 50 Per Cent Maturity

The perusal of data in Table 3 Days to 50 per cent maturity was 2 and 4 days earlier in the cultivar RD 2592 and BH 946 as compared to other cultivars. At the same time days to 50 per cent maturity was 18 days late in cultivar RD 2552, respectively. Days to 50 per cent maturity was 2 and 3 days early in cultivar RD 2592 and BH 946 as compared to other cultivars. At the same time days to 50 per cent maturity was 18 days late in cultivar RD 2552, respectively.

3.5 Grain and Straw Yield

Grain yield was significantly influenced by different cultivars Table 4. Cultivar RD 2552 was recorded significantly higher grain yield followed by RD 2592 and BH 946 whereas lowest grain yield was observed under cultivar RD 2097 compared to other cultivars. Yield is not an independent character but a product of a number of constellation of yield contributing characters such as tillers per plant, spike length, grain per spike, test weight which form the 'sink' and the harvest index which are considered directly related to yield. The higher yield of barley cultivar RD 2552 under salinity may be attributed to its higher number of tillers, long spike length, more number of grains per spike, higher test weight and harvest index. Same is the case with other cultivars RD 2592 and BH 946. These findings

Table 1. Effect of Salinity on Response of barley cultivars on plant population m^{-2} at 20 DAS and at harvest

	Plant population (m^{-2})	
Cultivars	**At 20 DAS**	**At Harvest**
RD2715	43.81	43.14
RD2035	47.88	45.06
RD2592	55.56	49.04
RD2849	53.02	45.01
RD2860	51.28	43.21
RD2552	46.85	52.91
RD2668	37.65	42.50
RD2097	22.94	38.95
BH946	67.33	48.14
RD2052	45.56	38.49
S.Em±	6.96	1.12
CD at 5%	NS	3.34

Table 2. Effect of salinity on response of barley cultivars on plant height at 30, 60 DAS and at harvest

	Plant height (cm)		
Cultivars	**At 30 DAS**	**At 60 DAS**	**At Harvest**
RD2715	21.9	72.3	90.61
RD2035	24.2	77.8	94.62
RD2592	22.7	74.7	94.59
RD2849	23.1	75.6	93.57
RD2860	18.6	64.9	84.86
RD2552	28.4	82.9	100.37
RD2668	20.34	70.5	90.18
RD2097	19.6	68.2	87.26
BH946	26.5	79.4	96.48
RD2052	27.4	80.6	98.43
S.Em .±	1.43	0.90	1.59
C.D. at 5 %	4.25	2.68	4.73

Table 3. Effect of Salinity on Response of barley cultivars on days to 50 per cent heading

Cultivars	Days to 50 per cent heading	Days 50 per cent maturity
RD2715	65.22	98.01
RD2035	76.31	108.32
RD2592	79.33	111.15
RD2849	70.21	102.23
RD2860	72.34	104.05
RD2552	82.33	113.25
RD2668	74.23	106.17
RD2097	63.21	95.03
BH946	78.66	109.11
RD2052	74.66	100.13
S.Em.±	2.59	3.22
C.D. at 5 %	7.70	9.59

Table 4. Effect of salinity on yield of barley crop

Cultivars	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})
RD 2715	26.21	45.91
RD 2035	39.41	52.61
RD 2592	42.41	58.71
RD 2849	36.66	41.81
RD2860	37.26	45.21
RD 2552	45.21	67.71
RD 2668	38.81	51.81
RD 2097	18.26	31.51
BH 946	41.73	64.21
RD 2052	28.61	40.81
S.Em.±	0.59	0.68
C.D. at 5%	1.79	2.02

are in conformity with the results reported by Sardhana et al. [31], Jat and Singh (2003), Chakravarty and Kushwah [32] and Rawat [33].

Among the all cultivars maximum straw yield (67.71 q ha^{-1}) was recorded in cultivar RD 2552, being significantly higher than all other cultivars. However, lowest straw yield was obtained in RD 2097 (31.51 q ha^{-1}), respectively. All the barley cultivars under study showed significant variation and thus exerted variable effect on straw yield. This was mainly due to the fact that grain and biological yields increased almost in different pattern during the period of season. Similar results were founded by Chandra and Das [34] and Cui et al. [35]. Our results are in conformity with Alam [36] and Kabir (2009).

4. CONCLUSIONS

Among the barley cultivars RD-2552, RD-2592 and BH-946 were quite encouraging under salinity condition with respect to growth, yield and economics. RD-2552, RD-2592 and BH-946 cultivars exhibited highest yield among the rest of promising barley cultivars tested under salinity condition. It was showed that cultivar RD 2552 gave the highest net return and benefit cost ratio which was found statistically superior over RD 2592.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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