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Studies on Morphological and Seed Quality Parameters in Buckwheat (*Fagopyrum esculentum* Moench) Germplasm

Anjay Singh Bisht[1*], Arun Bhatt[2], Bhim Jyoti[3] and Piyusha Singh[4]

[1,2]Dept. of Seed Science and Technology, [3,4]Dept. of Crop Improvement, V. C. S. G. Uttarakhand University of Horticulture and Forestry, College of Forestry, Ranichauri, Tehri Garhwal, Uttarakhand (249 199), India

Corresponding Author

Anjay Singh Bisht
e-mail: anjaybisht250@gmail.com

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Abstract

The present investigation was carried out during *kharif* season 2013 at the Research Block, Department of Crop Improvement for field experiment and further subsequent seed quality parameters were assessed in Seed Testing Laboratory for thirty diverse germplasm line of buckwheat including four check varieties *i.e.* PRB-1, Himpriya, VL-7 and Shimla-B1. Maintenance of morphological parameters, seed viability and vigour is crucial for success of any crop production programme as the sowing of deteriorated seed leads to sub optimal plant stand and crop performance. Among all the germplasm earliest flowering was noticed in RSR/SKS-106 (43 days) and day to maturity was noticed in IC-412733 (111 days). The maximum plant height (121.06 cm) was observed in PRB-1. Maximum number of primary branches per plant was recorded for PRB-1 (4.13) and VL-7 showed highest number of internodes plant^{-1} (12.86). PRB-1 (29.40) has highest number of leaves per plant while, PRB-1 was the best germplasm for highest seed yield plant^{-1} (3.45 g). The significantly highest germination percent was recorded for VL-7 (95%), while the minimum percent of standard germination was observed for IC-36805 (72%). The largest seedling length was measured for VL-7 (20.34 cm). The significantly maximum value of vigour index-I was observed for VL-7 (1900) germplasm. It is significant to mention that results of present study have helped to select better germplasm on the basis of morphological parameters and seed quality parameters in buckwheat. Out of 30 germplasm VL-7, PRB-1, IC-36805, IC-107988 and IC-26599 can be further utilized in crop improvement programme which is suitable for mid hills of Uttarakhand.

Keywords: Buckwheat, morphological parameter, seed quality, vigour

1. Introduction

Common buckwheat (*Fagopyrum esculentum* Moench) is herbaceous erect annual plant with diploid chromosome number (2n=16) it belongs to the family Polygonaceae. Buckwheat is one of the most important pseudo cereal crop of the mountain region widely cultivated in the middle and higher Himalayas between 1800 m and 4500 m asl in kharif season. Buckwheat is originated in temperate Central Asia.

In India this crop is grown on large scale in Jammu and Kashmir, Himanchal Pradesh and Uttarakhand and to some extent in Northern states *i.e.* Sikkim, Assam, Arunanchal Pradesh, Nagaland, and Manipur. It is also sporadically cultivated in the Niligiris and Palni hills in Southern India (Joshi, 1999). Systematic research work in India on pseudocereals was started with the identification and strengthing of programme under the All India Coordinated Research Network Project on Underutilized Crops taking into consideration the potential of these crop the new name of the project in All India Cordinator Research Network Project on Potential Crop when it 2013–14 onwards.

Buckwheat is having high nutritive value, It contains 11 to 15% protein which is deposited in the embryo and in the aleurone layer (Mazza, 1993). It has excellent protein quality in terms of essential amino-acid like lysine that are deficient in cereal crop.The tender shoots are used as leafy vegetables (Tomotake et al., 2000). The flower and green leaves are used for extraction of rutin, a glucoside used for medicinal purpose to prevent rupture of arteries. The flower of buckwheat produces honey of excellent quality. The seed used in a number of culinary preparation as well as alcoholic drinks. The crop has soil binding ability and checks soil erosion and is used as a green manuring crop (Joshi and Paroda, 1991).

Cultivar identification has attained critical importance in the national and international seed programme as it is realized that if true to type seed of a variety is not available then the entire crop production programme may fail. Thus it is of paramount importance to characterize varieties for their correct identification (Cooke, 2003). Cultivars are commonly

identified on the basis of morphological differences of seed, seedling and mature plant. Maintenance of morphological parameters, seed viability and vigour are crucial for success of any crop production programme as the sowing of deteriorated seed leads to sub optimal plant stand (Shelar, 2007) and crop performance (Egli and TeKrony, 1979; Pallavi et al., 2003). Seed plays an important role in sustainable agriculture because it is basic and primary material for propagation. Seed quality means seed of improved variety which have physical and genetic purity, high germination and vigour and free from insect pest and have optimum moisture content. The ultimate objective of testing seeds for germination and vigour is to gain information about planting value of seed under laboratory as well as field condition and obtained results can be used to compare different germplasm of buckwheat.

2. Materials and Methods

The present investigation was carried out during *kharif* season 2013 at the Research Block, Department of Crop Improvement for field experiment and further subsequent seed quality parameters were assessed in Seed Testing Laboratory of department of Seed Science and Technology, V.C.S.G. Uttarakhand University of Horticulture and Forestry, College of Forestry, Ranichauri, Tehri Garhwal, Uttarakhand.

The experimental materials for present invstigation comprised of 30 germplasm viz., IC-13507, IC-294344, IC-412733, IC-412762, IC-13446, IC-13454, IC-13458, IC-13533, IC-13544, RSR/SKS-71, RSR/SKS-84, RSR/SKS-104, RSR/SKS-106, IC-26598, IC-26599, IC-36805, IC-36914, IC-37265, IC-42426, IC-107988, IC-108516, IC-109309, IC-204020, IC-329200, IC-341661, IC-276627 of Buckwheat (*Fagopyrum esculentum* Moench) including four check varieties *i.e.* Himpriya, VL-7, Shimla-B1 and PRB-1. The seed material of 26 germplasm and four check varieties used in the study was procured from Project Coordinator Unit of All India Coordinated Research Project on Under Utilized crop, NBPGR, regional station Shimla.

The field parameter was conducted in Randomized Block Design with three replications and observations was recorded on Days to 50% flowering, Days to maturity, Plant height at maturity (cm), Number of primary branches per plant, Number of secondary branches plant^{-1}, Number of internodes plant^{-1}, Number of leaves plant^{-1}, Leaf length (cm), 100-seed weight (g), Seed yield plant^{-1} (g). While, the laboratory experiment was conducted in Complete Randomized Block Design with four replications and observation was recorded on First count test, Standard germination (%), Root length (cm), Shoot length (cm), Seedling length (cm), Seedling fresh weight (g), Seedling dry weight (g). The seedlings vigour index was calculated by two different methods (Abdul Baki and Anderson, 1973).

Seedling vigour index I=Standard germination (%)×Seedlings length (cm)

Seedlings vigour index II =Standard germination (%)×Seedling dry weight (g)

3. Results and Discussion

The mean performance of 30 germplasm of buckwheat with respect to different morphological and seed quality parameters are discussed for assessment of germination and vigour parameters.

3.1. Morphological parameters

The maximum days to 50% flowering was recorded in Shimla-B1 (66 days) followed by IC-107988 (66 days), whereas, earliest flowering was observed in RSR/SKS-106 (43 days). The lowest value for days to maturity was observed in IC-412733 (111 days) and IC-329200 (111 days), While highest value for days to maturity was found in IC-13458 (125 days) and IC-26599 (125 days) with general mean 118.73 days. The mean plant height ranged from 80.53 cm to 121.06 cm. significantly highest plant height was observed in PRB-1 (121.06 cm) followed by IC-276627 (120.90 cm) (Table-1). Plant height is good index of plant vigour which may contribute towards productivity. The plant growth can also serve as a guide to determine the suitable planting distance for a crop and the optimum plant population per unit area for harvesting maximum yields. A range of high variability in above characters desirable for selecting the germplasm for earliness. Similar results were also reported by Rana and Sharma (2000) Naseem et al. (2007); Debnath et al. (2008). The PRB-1 showed the highest number of primary branches plant^{-1} (4.13) while, lowest value for number of primary branches was observed in IC-329200 (2.73) with overall mean 3.36 and IC-372655 showed highest number of secondary branches plant^{-1} (11.86) with overall mean of 10.37. VL-7 had maximum number of internodes plant^{-1} (12.86) whereas, minimum number of internodes plant^{-1} was observed in IC-294344 (8.20) with an overall mean 10.25. Range of number of leaves plant^{-1} was observed from 20.20 to 29.40 and highest number of leaves plant^{-1} was observed in PRB-1 (29.40) with overall mean 23.93. The germplasm IC-13533 showed highest 100-seed weight (2.23 g) while, minimum 100-seed weight was recorded in RSR/SKS-104 (1.23 g) with overall mean 1.66 g. The ranged of seed yield plant^{-1} was varied from 2.07 g to 3.45 g among the germplasm. The highest value for seed yield plant^{-1} was showed in germplasm PRB-1 (3.45 g) followed by IC-13533 (3.28 g) while, the lowest value for seed yield plant^{-1} (2.07 g) was found in IC-37265 with the overall mean 2.79 g (Table 1). Seed yield is a major determinant variable for selecting a particular crop/variety for its commercialization and income generation capability. The above results indicated a wide range of variability in across the germplasm and check varieties. Extent of variability in above finding might be due to different genetic makeup of the germplasm and various area of adaptation coupled with environmental interaction. Variation in above characters was also reported by Dutta et al. (2008); Joshi (1999); Rana and Sharma (2000), Naseem et al. (2007); Debnath et al. (2008).

3.2. Seed quality parameters

The highest value of first count (50%) was recorded for IC-

107988 with overall mean 41.33%. The significantly highest germination percent was recorded for VL-7 (95%) which was statistically similar with IC-13454 (93%). The minimum percent of standard germination was observed for IC-36805 (72%)

Table 1: Mean performance of buckwheat germplasm for different field parameters

Sl. No.	Character/ genotypes	Days to 50% flowering	Days to maturity	Plant height at maturity (cm)	No. of primary branches plant^{-1}	No. of secondary branches plant^{-1}	No. of internodes plant^{-1}	No. of leaves plant^{-1}	Leaf length (cm)	100-seed weight (g)	Seed yield plant^{-1} (g)
1.	IC-13507	62	114	89.86	3.40	9.13	8.26	21.33	5.45	1.33	2.26
2.	IC-294344	49	119	110.26	3.26	10.13	8.20	22.80	5.23	1.41	3.23
3.	IC-412733	44	111	115.06	3.73	10.00	10.80	24.40	5.94	1.45	2.44
4.	IC-412762	44	119	97.26	3.26	9.53	9.13	27.20	5.66	1.89	3.07
5.	IC-13446	44	121	90.26	2.80	9.93	11.73	25.80	6.03	2.09	2.18
6.	IC-13454	57	120	95.06	3.60	11.13	8.40	26.13	5.87	1.45	2.96
7.	IC-13458	55	125	84.33	3.60	9.06	11.26	20.60	6.46	1.75	2.80
8.	IC-13533	56	116	81.73	3.20	8.86	10.20	20.53	6.04	2.23	3.28
9.	IC-13544	55	120	83.66	3.06	10.46	8.46	22.13	5.16	1.29	3.11
10.	RSR/SKS-71	44	120	109.00	3.53	10.46	8.60	27.60	5.25	2.05	3.24
11.	RSR/SKS-84	64	119	118.06	3.53	10.93	12.20	20.80	5.96	1.74	3.09
12.	RSR/SKS-104	44	121	87.46	3.20	9.46	11.06	22.86	6.40	1.21	3.24
13.	RSR/SKS-106	43	117	112.40	3.20	9.93	11.13	28.06	6.94	1.75	2.16
14.	IC-26598	64	112	85.80	2.86	10.93	8.73	23.53	5.70	1.63	2.13
15.	IC-26599	64	125	116.66	3.40	11.60	9.66	24.73	5.34	1.70	2.50
16.	IC-36805	60	118	100.33	3.33	10.26	11.06	20.46	6.29	1.73	3.20
17.	IC-36914	61	121	104.20	3.26	10.26	9.00	21.80	6.26	1.88	2.54
18.	IC-37265	65	123	102.00	3.33	11.86	10.40	20.53	6.94	1.73	2.07
19.	IC-42426	64	118	80.96	3.53	11.40	9.33	26.13	5.88	1.50	2.85
20.	IC-107988	66	124	95.80	2.93	10.13	11.60	26.46	4.52	1.73	3.19
21.	IC-108516	64	121	104.93	3.53	10.40	11.86	26.46	4.95	1.66	2.61
22.	IC-109309	55	118	81.40	3.26	10.33	12.46	28.20	5.10	1.48	2.20
23.	IC-204020	59	121	81.00	3.20	10.80	8.80	20.20	5.85	1.29	3.21
24.	IC-329200	65	111	116.20	2.73	10.46	9.53	26.53	5.20	1.85	3.12
25.	IC-341661	57	115	90.40	3.46	10.20	9.93	21.00	6.10	1.43	2.22
26.	IC-276627	51	124	120.90	3.26	11.20	8.33	27.20	5.92	2.04	2.89
27.	PRB-1	58	121	121.06	4.13	11.40	11.66	29.40	6.02	1.86	3.45
28.	Himpriya	44	115	99.00	3.53	11.06	11.33	23.00	5.54	1.63	3.11
29.	VL-7	46	114	103.40	3.93	11.40	12.86	20.73	4.84	1.80	2.84
30.	Shimla-B1	66	119	80.53	3.66	10.46	11.66	21.26	5.88	1.39	2.62
GM		55.66	118.73	98.63	3.36	10.37	10.25	23.93	5.77	1.66	2.79
CV (%)		3.60	1.34	3.46	8.46	3.33	5.75	3.06	11.81	6.79	4.00
SEM±		1.15	0.92	1.97	0.16	0.19	0.34	0.42	0.39	0.06	0.06
CD (p=0.05)		3.28	2.60	5.58	0.46	0.56	0.96	1.20	1.11	0.18	0.18
Minimum		43	111	80.53	2.73	8.86	8.20	20.20	4.52	1.21	2.07
Maximum		66	125	121.06	4.13	11.86	12.86	29.40	6.94	2.23	3.45

with overall mean 84.36%. The range of seedling length varied from 13.96 cm to 20.34 cm. The largest seedling length was measured for VL-7 (20.34 cm) followed by RSR/SKS-84 (18.26 cm) however, smallest seedling length recorded for IC-42426 (13.96 cm) with general mean of 16.33 cm. The mean value for seedling fresh weight was varied from 1.06 g to 1.70 g. The maximum value of seedling fresh weight was observed for IC-26599 (1.70 g). The range of seedling dry weight varied from 0.17 g to 0.40 g for different germplasm of buckwheat and the significantly highest value of seedling dry weight (0.40 g) was recorded for VL-7 with overall mean 0.27 g. (Table 2). It was observed that seed vigour characters singly were not as effective for identification of varieties but when applied in combination with other characters these were quite effective. Seedling dry weight had significantly positively correlated with seedling length and seedling fresh weight. These results

Table 2: Mean performance of buckwheat germplasm for different seed quality parameters

Sl. No.	Character/ genotypes	First count (%)	Standard germination (%)	Root length (cm)	Shoot length (cm)	Seedling length (cm)	Seedling fresh weight (g)	Seed-ling dry weight (g)	Vigour Index-I	Vigour Index-II
1.	IC-13507	41	83	10.74	3.61	14.33	1.29	0.20	1188	17
2.	IC-294344	45	84	10.96	4.25	15.21	1.22	0.31	1245	26
3.	IC-412733	37	87	11.38	3.88	15.26	1.33	0.35	1321	30
4.	IC-412762	40	84	11.74	4.28	16.02	1.17	0.33	1346	28
5.	IC-13446	44	84	13.34	4.09	17.42	1.25	0.31	1396	26
6.	IC-13454	35	93	12.99	3.88	16.87	1.19	0.34	1598	32
7.	IC-13458	41	85	12.55	4.68	17.24	1.27	0.23	1473	20
8.	IC-13533	39	83	12.93	4.13	17.06	1.38	0.30	1410	25
9.	IC-13544	47	92	11.78	5.43	17.22	1.20	0.21	1586	20
10.	RSR/SKS-71	42	83	13.67	4.26	17.93	1.06	0.30	1480	25
11.	RSR/SKS-84	49	91	13.93	4.33	18.26	1.12	0.31	1659	29
12.	RSR/SKS-104	33	85	12.47	4.04	16.51	1.32	0.38	1409	33
13.	RSR/SKS-106	37	89	12.04	4.26	16.42	1.50	0.18	1468	17
14.	IC-26598	45	81	12.29	4.03	16.32	1.40	0.17	1330	14
15.	IC-26599	31	81	11.35	4.08	15.64	1.70	0.25	1272	21
16.	IC-36805	47	72	12.36	4.23	16.10	1.28	0.32	1160	23
17.	IC-36914	47	80	12.49	3.60	16.10	1.49	0.33	1287	26
18.	IC-37265	43	83	11.11	3.48	14.60	1.36	0.30	1207	25
19.	IC-42426	45	82	10.64	3.32	13.96	1.20	0.25	1135	21
20.	IC-107988	50	84	12.19	6.52	17.02	1.30	0.25	1432	21
21.	IC-108516	31	85	11.82	4.32	16.14	1.42	0.26	1398	23
22.	IC-109309	45	79	12.25	4.13	16.38	1.46	0.21	1291	17
23.	IC-204020	41	81	11.66	3.72	15.38	1.40	0.25	1251	21
24.	IC-329200	43	80	12.78	4.46	17.20	1.34	0.22	1370	18
25.	IC-341661	47	84	12.06	4.04	16.10	1.11	0.30	1351	25
26.	IC-276627	49	83	11.18	3.56	14.75	1.27	0.26	1219	22
27.	PRB-1	33	83	10.40	3.83	14.24	1.22	0.25	1177	21
28.	Himpriya	39	83	14.00	3.90	17.90	1.58	0.17	1480	15
29.	VL-7	43	95	15.38	4.96	20.34	1.38	0.40	1900	38
30.	Shimla-B1	31	92	11.66	4.42	16.08	1.51	0.19	1479	18
GM		41.33	84.36	12.20	4.19	16.33	1.32	0.27	1377.26	23.23
CV (%)		5.67	4.55	5.43	19.20	6.34	8.04	17.42	7.53	17.33

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Character/ geno-types	First count (%)	Standard germination (%)	Root length (cm)	Shoot length (cm)	Seedling length (cm)	Seedling fresh weight (g)	Seed-ling dry weight (g)	Vigour Index-I	Vigour Index-II
SEM±	1.35	2.21	0.38	0.46	0.59	0.06	0.02	59.87	2.33
CD (*p*=0.05)	3.83	6.27	1.08	1.31	1.69	0.17	0.78	169.39	6.59
Minimum	31	72	10.40	3.32	13.96	1.06	0.17	1135	14
Maximum	50	95	15.38	6.52	20.34	1.70	0.40	1900	38

were agreement with the finding of Naseem et al. (2007) on buckwheat, Sarlach et al. (2008) in wheat, Arivazhagen and Kadarmohideen (2006) and Tzortzakis (2009) in amaranth. The significantly maximum value of vigour index-I was observed for VL-7 (1900) germplasm with overall mean 1377.26. The highest vigour index-II was observed for VL-7 (38) followed by RSR/SKS-104 (33) with overall mean 23.23, (Table-2). Seedling vigour index-II is helpful in monitoring and ensuring the survival and growth rate of seedling after germination that are determinate plant establishment. Higher degree of germination and seedling dry weight ensure the production of higher vigour index-II. Germination percent and seedling length were the only two factors for deciding the vigour index. The significant variation for different germplasm, which might be due to diverse genetic constitution of germplasm and needed to be exploited in crop improvement programme.. Results of present finding were reported by Patil et al. (1999) and Krishnappa et al. (2001) for finger millet. Kumar et al. (2015) reported that the seed vigour is an important character in Amaranth.

4. Conclusion

The morphological and seed quality parameters are crucial for success of any crop production programme by selection and identification of better germplasm. It is also concluded the assessment of genetic diversity in germplasm will help to increase economic trait by developing high yielding varieties in crop breeding. Out of 30 germplasm VL-7, PRB-1, IC-36805, IC-107988 and IC-26599 was suitable for under field and laboratory condition. So these germplasm can be further utilized in crop improvement programme which is suitable for mid hills of Uttarakhand.

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