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Evaluation of buckwheat (*Fagopyrum esculentum* Moench.) genotypes under northern dry zone of Karnataka

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Abstract
An experiment was carried out on evaluation of buckwheat (*Fagopyrum esculentum.* Moench.) genotypes under Northern dry zone of Karnataka during *rabi* - 2019-20 at department of Plantation, Spices, Medicinal and Aromatic crops, College of Horticulture, Bagalkot. The experiment was laid out in Randomized complete block design (RCBD) with fifty treatments and two replications at 30 X 10 cm spacing under open field. Wide variation was observed among the genotypes for all morphological and yield traits. Among the fifty genotypes, EC-99947 took minimum days to germination (4.00) and showed maximum plant height (71.50 cm). The genotype IC 79147 took minimum days to 50 percent flowering (24.00). The genotype EC 286396 (62.62) was found to be early maturity. The genotype IC-313136 showed maximum number of branches (16.06), number of inflorescence (27.40), seed yield per plant (7.87g), seed yield per ha (17.49 q), straw yield per plant (6.28g), straw yield per hectare (13.94 q/ha) and protein (14.77%). The 1000 seed weight was highest in IC-79147 (3.40 g) and the genotype EC-99947 showed highest harvest index (54.65%). The maximum rutin content was observed in PRB 1 (406.66 mg/100g). Among the genotypes evaluated IC-313136 and IC-79147 were found suitable to grow under northern dry zone of Karnataka based on growth and yield attributes.

Keywords: buckwheat, *Fagopyrum esculentum.* Moench., genotypes, protein, rutin

1. Introduction
India is known as one of the richest countries in the world in terms of biodiversity, which consist of 15 agro-climatic zones. According to World Health Organization (WHO) eighty per cent of people worldwide depend on herbal medicines for their primary health care. Out of 17000-18000 flowering plants, more than 7000 species are being used as medicinal plants. *Fagopyrum esculentum* Moench.(Common Buckwheat) is an annual, herbaceous, erect plant, belongs to the family *Polygonaceae*, with diploid chromosome number 2n=16. It is native of temperate Central Asia. There are two types of buckwheat namely, common buckwheat (*Fagopyrum esculentum.* Moench.) and tartary buckwheat (*Fagopyrum tataricum* Gaertn.). The term "buckwheat" is derived from two Anglo-Saxon terms, boc (beech) and whoet (wheat) by the Scottish, it is similar to beech nut (Edwardsen, 1995; Berglund and Duane, 2003) [9, 3]. In India, buckwheat is commonly known as ogal, phaphar and kuttu.
Buckwheat is mainly cultivated in the temperate zones of the northern hemisphere especially in Russia (Oshini, 2004) [23]. It is cultivated over an area of 2.4 million hectares with the production of 2.4 million tons and productivity of 1000 kg/ha. Russia ranks first with respect to area (1.12 million hectare) and production (1.19 million tons) followed by China and Ukraine. France has the highest productivity (3735 kg/ha) in the world (FAO STAT, 2018) [10]. Buckwheat is widely distributed in the Himalayan region, more diversity exists in Western Himalayan region in North India and Palni and Nilgiri hills in South India (Rana *et al.*, 2005) [29]. The major buckwheat growing states in India are Himachal Pradesh, Jammu and Kashmir, Uttarakhand, West Bengal, Sikkim, Assam, Arunachal Pradesh, Meghalaya, Nagaland, Manipur, Kerala, Chhattisgarh and Tamil Nadu (Rana *et al.*, 2012) [28].
Buckwheat is a gluten-free grain crop that can be used in celiac disease diets (Mazza and Oomah 2005; Sytar *et al.* 2016) [21, 33]. When compared to other cereals, buckwheat has a relatively higher nutritional value. According to biochemical analyses of buckwheat germplasm, seeds are an excellent source of starch, proteins, fats, dietary fiber, vitamins, minerals, and phenolic components (Bobkov 2016) [5].

Buckwheat has a higher protein content than other cereals (Sytar *et al.* 2018) [34].

The rutin (flavonoid) is the most important ingredient present in this plant. The rutin increases capillary fragility, hypertension, leading to haemorrhage, purpurea, varicose veins, prevents atherosclerosis, improve digestion and kidney bleeding. It has anti-carcinogenic property. Generally, tartary buckwheat contains about 100 times more rutin than common buckwheat (Suzuki and Morishita, 2016) [32].

The buckwheat is a very hardy and climate resilient crop which has the ability to withstand under poor and marginal soils and even under stress condition. The buckwheat is one of the important nutritional and underutilized crop for marginal land. The cultivated area of buckwheat in south India is meager. Karnataka is one of the agriculturally important states of India with no area under buckwheat. It is essential to introduce buckwheat in non-traditional area and find suitable elite genotypes for future expansions of area under buckwheat in dry regions. With this background, the present evaluation for growth, yield and quality was carried out involving 50 genotypes.

2. Material and Methods

The present research was undertaken during *rabi*-2020-21 at department of Plantation, Spices, Medicinal and Aromatic Crops (PMA), College of Horticulture, Bagalkot to evaluate the performance of 50 genotypes with two replications in Randomized complete block design (RCBD) at spacing of 30 cm x 10 cm. To produce a healthy crop, recommended agronomical methods were followed. The recommended fertilizer dosage (40: 20: 10 NPK kg/ha) was added in the form of urea at 86.95 kg/ha, single super phosphate (SSP) at 125 kg/ha, and muriate of potash (MOP) at 16.00 kg/ha. The seeds were line sown at the recommended seed rate (35 - 40 kg/ha) and sown separately in respective plots. A total of seven irrigations were administered in the entire cropping period. The observations on days to germination, plant height, number of branches, days to 50 per cent flowering, number of inflorescences, seed yield, test weight, dehusked seed weight, straw yield, harvest index, protein and rutin content were recorded following standard procedures. For the analysis, mean data from each replication were used. The protein content in seed was estimated by Kjeldal method by nitrogen content. The rutin content in seeds was determined by using HPLC method (High pressure liquid chromatography) (Podolska *et al.*, 2021) [27]. The 50 genotypes were collected from the department of genetics and plant breeding, University of Agricultural Sciences, Dharwad.

T_1 : Local Collection	T_{14} : IC-313152	T_{27} : IC-42414	T_{40} : EC-286396
T_2 : Rani Chouri local-1	T_{15} : IC-328691	T_{28} : IC-42415	T_{41} : EC-3222
T_3 : Rani Chouri local-3	T_{16} : IC-107298	T_{29} : IC-42425	T_{42} : EC-323724
T_4 : Sangla B-1	T_{17} : IC-329202	T_{30} : IC-49671	T_{43} : EC-323729
T_5 : Sangla B-460	T_{18} : IC-37269	T_{31} : IC-79147	T_{44} : EC-386667
T_6 : Nilgiri local	T_{19} : IC-37271	T_{32} : IC-79238	T_{45} : EC-386668
T_7 : Himapriya	T_{20} : IC-37281	T_{33} : EC-104035	T_{46} : EC-99947
T_8 : PRB-1	T_{21} : IC-37304	T_{34} : EC-125357	T_{47} : IC-107671
T_9 : Shimla B-1	T_{22} : IC-37309	T_{35} : EC-125937	T_{48} : IC-313136
T_{10} : VL-7	T_{23} : IC-412733	T_{36} : EC-125940	T_{49} : IC-313134
T_{11} : IC-313139	T_{24} : IC-412687	T_{37} : EC-18864	T_{50} : IC-274429
T_{12} : IC-313140	T_{25} : IC-42401	T_{38} : EC-218742	
T_{13} : IC-313142	T_{26} : IC-42412	T_{39} : EC-218784	

3. Results and Discussion

The genotypes differed significantly for all morphological, yield and quality traits. The days to germination ranged between 4.00 and 8.00. Among the 50 genotypes, days to early commencement of germination was recorded minimum in EC 99947(4.00), which was on a level with IC 79147 (4.4), EC 323729 (4.50), Rani chouri local 1 (4.50), Sangla B 460 (5.00), EC 386667 (5.00), EC 386667 (5.50), EC 286396 (5.5), IC 49671 (5.50) and PRB 1 (5.50). The delayed commencement of germination was noticed in IC 313136 (8.00) and EC 323724 (8.00). This variation in germination was due to the genetic composition of genotypes and interaction with the environment. The reason for early germination was characterized by rapid water ingestion by seeds of various genotypes until the seed tissues were completely hydrated and late germination was observed in some buckwheat genotypes due to low uptake of water. There have been numerous previous findings that show differences or variation for germination among buckwheat genotypes (Bisht *et al.*, 2018) [4].

The plant height ranged between 38.70 cm and 71.50 cm. The genotype EC 99947 found maximum plant height (71.50 cm), which was on a level with EC 323729 (69.70 cm), IC 79147 (66.30 cm) and Rani chouri local 1 (65.30 cm). The minimum plant height was noticed in IC 107298 (38.70 cm).The variation in plant height caused by genotype genetic composition and interaction with suitable agroclimatic and soil conditions. The variation in plant height in buckwheat genotypes were also observed by Hongmei *et al.* (2003) [12]; Ghiselli *et al.* (2016) [11]; Hulihalli and Shanthaveerayya (2018) [13] and Bisht *et al.* (2018) [4].

The number of branches ranged between 8.72 and 16.06. The highest number of branches was noticed in IC 313136 (16.06) followed by IC 79147 (13.01) and EC 323729 (13.81). The lowest number of branches was found in EC 99947 (8.72).The genetic characteristics of a specific genotype, as well as its interaction with the environment in which it is developed, influence the development of branches. The present observations on buckwheat are in consonance with the Ghiselli *et al.* (2016) [11] and Bisht *et al.* (2018) [4].

The days taken to 50 per cent flowering range between 24.00 and 35.50. Rani chouri local 1, IC 79147, EC 323724 and EC 323729 took minimum days taken for 50 per cent flowering *i.e.*, 24.00 days, followed by IC 49671 (24.50), Sangla B 460 (24.50) and PRB 1 (24.50). Whereas, the maximum days taken for commencement of 50 per cent flowering was recorded in IC 313136and IC 328691(35.50 days). This is because of genotypic character, its interactivity with the surrounding environment and conversion of vegetative stage to reproductive stage might be different among the genotypes. There were several conflicting reports observed by Baniya (1995) [2]; Janovska and Paulickova (2007) [16] and Bisht *et al.*

(2018) [4].

The number of inflorescence was differed from 16.00 to 27.40. The genotype IC 313136 recorded maximum number of inflorescences (27.40), which was on level with IC 79147 (27.00), EC 323729 (26.60) and Rani chouri local 1 (25.90). EC 99947 recorded minimum number of inflorescences (16.00). This variation is dependent on the genotypic character and the genotypic character's responsiveness to the local environment. Previous researchers have also discovered considerable variation in the number of inflorescences per plant among buckwheat genotypes. Hulihalli and Shanthaveerayya (2018) [13], Maruti *et al.* (2018) [20] and Jacek *et al.* (2001) [15] reported the variability for number of inflorescence among the different genotypes of buckwheat.

The days to maturity of seeds varied from 62.62 to 75.00. The genotype EC 286396 took minimum days (62.62) to harvest, which was equivalent to EC 107671 (63.26), EC 323729 (63.51) and IC 107298 (63.52). The maximum days for maturity was observed in IC 313136 (75.00). This was because of genetic make-up and life cycle (short or long) of a genotype. The differences in crop duration of buckwheat were reported by Bisht *et al.* (2018) [4] and Joshi *et al.* (2011) [17].

The seed yield per plant range between 2.03 g and 7.87 g. The maximum seed yield per plant was observed in IC 313136 (7.87 g), which was on par with EC 323729 (7.53 g), IC 79147 (7.74 g) and Rani chouri local 1 (7.32 g). The genotype IC 37271 recorded minimum seed yield per plant (2.03 g). The seed yield per hectare ranged from 4.51 to 17.49 q. The highest seed yield for hectare area was recorded in IC 313136 (17.49 q) followed by IC 79147 (17.19 q), EC 323729 (16.73 q), and Rani chouri local 1 (16.26 q). The seed yield for hectare was recorded lowest in IC 37271 (4.51 q). The variation in seed yield could be attributed to differences in growth and yield features such as number of branches, number of inflorescences per plant, test weight and thousand seed weight. The substantial differences in seed yield among buckwheat genotypes were noticed previously by several researchers such as Podolska and Podolski (2002) [26]; Janovska and Paulickova (2007) [16]; Sobhani *et al.* (2014) [30]; Ghiselli *et al.* (2016) [11]; Maruti *et al.* (2018) [20]; Idowu-Agida *et al.* (2020) [14] and Paul and Nandi (2020) [25].

The straw yield per plant ranged between 1.15 g and 6.28 g. The maximum straw yield per plant was recorded in IC 313136 (6.28 g), followed by IC 79147 (5.96 g) while, the minimum was found in IC 313152 (1.15 g). The straw yield per hectare range between 2.54 q and 13.94 q. The highest straw yield for one hectare area was recorded in IC 313136 (13.94 q) followed by IC 79147 (12.57 q), EC 323729 (12.13 q), and Rani chouri local 1 (11.60 q). The lowest straw yield for one hectare area was recorded in IC 313152 (2.54 q). The maximum variation in straw yield was due to longer periods of good vegetative growth accompanied by an increase in the number of branches. Similar records were reported by Sood and Rana (2004) [31]; Joshi *et al.* (2011) [17]; Kara (2014) [18]; Mariotti *et al.* (2016) [19]; Hulihalli and Shanthaveerayya (2017); Maruti *et al.* (2018) [20] and Anand *et al.* (2020) [1].

The harvest index varied from 12.68 to 54.65 per cent. The genotype EC 99947 recorded maximum harvest index of (54.65%), which was found on par with EC 323729 (52.00%) and IC 79147 (51.57%) whereas, the harvest index was recorded minimum in EC 323724 (12.68%). The highest harvest index was observed as a result of highest seed yield in a plant with less biological yield per plant. Similar findings were noticed by Paulsamy (1995) [24] and Ghiselli *et al.* (2016) [11].

The thousand seed weight significantly differed among the buckwheat genotypes (Table 1). The test weight of seeds ranged between 0.82 g and 3.40g. The maximum test weight was noticed in IC 79147 (3.40 g), which was on a level with the EC 323729 (3.36 g), Rani chouri local 1 (3.29 g) and EC 386668 (3.27 g). The genotype IC 49671showed least test weight of 0.82 g. The maximum test weight is due to boldness and maximum filling of the seeds in buckwheat. These findings are in line with the reports of Diksha and Awasthi (2014) [6]; Maruti *et al.* (2018) [20] and Paul and Nandi (2020) [25].

The dehusked seed weight ranged from 0.30 g to 1.88 g. The highest dehusked seed weight was in IC 79147(1.88 g), which was on par with EC 323729 (1.84 g), Rani chouri local 1 (1.77 g) and EC 386668 (1.75 g). The genotype IC 313152showed least test weight of 0.30 g.The variation in dehusked seed weight was mainly due to boldness, filling of seed, thick seed husk and genotypic character of the genotype.

The protein content varied from 9.03 to 14.77 per cent. The maximum protein content was observed in IC 313136 (14.77%), followed by IC 79147 (14.23%), EC 323729 (13.98%) and Rani chouri local 1 (13.78%). Whereas, minimum was found in IC 313152 (9.03%).This could be due to genotypic interactions with the environment, as well as the crop's maturity, which influences the protein content. Similar records were observed in Dogra and Awasthi (2015) [7]; Dziadek *et al.* (2016) [8] and Monika *et al.* (2017) [22].

The rutin content in seeds range between 257.22 and 406.66 mg/100g. The maximum rutin content was observed in PRB 1 (406.66 mg/100g), followed by IC 274429 (389.63 mg/100g) and Sangla B 460 (386.22 mg/100g). The genotype IC 313136 recorded minimum rutin content (257.22 mg/100g) Table 2.

Table 1: Growth, yield and quality parameters of buckwheat (*Fagopyrum esculentum* Moench.) genotypes.

Genotypes	Days to germination	Plant height (cm)	Number of branches	Days to 50% flowering	Number of inflorescences	Days to maturity	Seed yield per plant (g)	Seed yield per ha (q)	Straw yield per plant (g)	Straw yield per ha (q)	Harvest index (%)	Test weigh t (g)	Dehusked seed weight (g)	Protein (%)
Local collection	6	56.9	10.96	25	23	65.06	3.9	8.67	1.99	4.42	32.61	2.85	1.34	10.68
Rani chouri local 1	4.5	65.3	12.7	24	25.9	64.05	7.32	16.27	5.22	11.6	44.3	3.29	1.77	13.78
Rani chouri local 3	6	58	10.85	25	23	65.04	3.65	8.11	1.77	3.3	32.61	2.92	1.41	11.79
Sangla B 1	6	62.7	11.06	25	23	67.82	4.19	9.31	3.43	7.61	33.29	2.94	1.43	12.65
Sangla B 460	5	62.9	11.88	24.5	24.6	64.04	6.57	14.6	4.86	10.79	41.32	3.22	1.7	13.21
Nilgiri local	6	62.7	11.06	25	23.3	64.52	4.35	9.67	3.58	7.72	33.6	2.94	1.43	12.71
Himapriya	6	55.7	10.85	25	23	65.07	3.07	6.82	1.93	4.07	32.07	2.86	1.35	11.09
PRB 1	5.5	64.3	11.57	24.5	24.3	64.22	5.51	12.24	4.35	9.67	39.27	3.1	1.58	13.16
Shimla B 1	6	62.9	11.06	25	23.3	65.16	4.48	9.95	3.62	7.94	33.72	2.95	1.44	12.71
VL 7	6.5	58.9	10.85	25.5	22.9	64	3.69	8.2	2.78	6.17	32.04	2.85	1.34	10.13
IC 313139	6.5	61	10.85	25.5	22.8	66.17	3.08	6.84	1.63	4.27	32.03	2.76	1.25	10.97
IC 313140	6.5	57.7	10.65	25.5	22.8	65.95	3.2	7.11	2.45	5.44	31.24	2.75	1.24	11.54

IC 313142	6.5	59.1	10.65	25.5	22.6	65.95	2.6	5.78	1.39	3.09	31.11	2.89	1.38	13.62
IC 313152	6.5	59.3	10.65	25.5	22.5	66	3.08	6.84	1.15	2.54	31.08	1.81	0.3	9.03
IC 328691	6	62.4	11.06	35.5	23.4	74.23	4.62	10.27	3.69	8.04	32.61	2.95	1.44	12.72
IC 107298	6.5	38.7	10.55	25.5	22.4	63.52	3.4	7.56	2.76	6.13	30.61	2.71	1.2	11.03
IC 329202	6.5	51.8	10.55	25.5	22.4	66.11	2.87	6.38	2.52	5.59	30.01	2.41	0.9	12.46
IC 37269	6.5	59.5	10.45	25.5	22.1	67.69	3.02	6.71	2.07	4.59	29.14	2.89	1.38	11.29
IC 37271	6.5	40.9	10.24	25.5	21.8	65.95	2.03	4.51	2.48	5.51	28.72	2.66	1.15	12.39
IC 37281	6.5	60.9	10.24	25.5	21.6	65.2	3.41	7.58	2.04	4.53	28.32	2.89	1.38	10.85
IC 37304	6.5	57.2	10.24	25.5	21.3	65.97	4.09	9.09	1.83	4.07	28.1	2.8	1.29	11.69
IC 37309	6.5	58.1	10.24	25.5	20.8	64.6	3.72	8.27	1.76	3.91	27.3	2.91	1.4	12.15
IC 412733	6.5	56.8	10.14	25.5	20.6	66.02	3.81	8.47	2.26	5.02	26.89	2.8	1.29	10.98
IC 412687	6.5	59.7	10.14	25.5	20.3	68.22	3.97	8.82	2.98	6.61	26.61	2.72	1.21	11.11
IC 42401	6.5	53.5	10.14	26	20.2	66.46	3.63	8.07	2.86	6.36	25.91	2.38	0.87	11.88
IC 42412	6.5	56.3	10.04	26	19.9	68.97	2.86	6.36	2.97	6.6	25.27	2.61	1.1	11.58
IC 42414	6.5	56.5	10.04	26	19.9	68.11	3.42	7.6	2.59	5.74	24.34	2.87	1.36	11.7
IC 42415	7	61	9.94	26	19.6	66.97	3.29	7.31	2.68	5.96	24.33	1.15	1.18	12.5
IC 42425	7	57.2	9.83	26.5	19.1	69.5	3.04	6.76	2.99	6.64	23.64	0.99	1.33	11.6
IC 49671	5.5	64.3	11.47	24.5	24.1	64.03	4.93	10.96	3.98	8.63	37.52	0.82	1.52	12.82
IC 79147	4.4	66.3	13.01	24	27	64.51	7.74	17.2	5.96	12.58	51.57	3.4	1.88	14.23
IC 79238	7.5	61.7	9.73	26.5	18.6	66.65	3.8	8.44	2.05	4.5	22.41	2.78	1.27	11.65
EC 104035	6	63.5	11.26	25	24	65.08	4.88	10.84	3.89	8.48	35.39	3.03	1.51	12.8
EC 125357	7.5	61.3	9.73	26.5	18.6	67.15	3.8	8.44	1.97	4.37	21.99	2.88	1.37	11.89
EC 125937	7.5	60.5	9.63	26.5	18.5	67.96	3.8	8.44	2.47	5.48	21.88	2.79	1.28	12.6
EC 125940	7.5	61.4	9.63	27	18.2	68.62	4.15	9.22	2.12	4.33	21.5	2.8	1.29	10.84
EC 18864	7.5	53.1	9.63	27	17.4	70.02	2.98	6.62	2.57	5.71	21.31	2.9	1.39	10.87
EC 218742	6	63.4	11.16	25	24	64.12	4.86	10.8	3.82	8.32	35.36	2.99	1.48	12.77
EC 218784	7.5	61.1	9.12	28	17.3	69.44	3.03	6.73	2.69	5.98	19.02	3.22	1.7	10.11
EC 286396	5.5	63.4	11.98	24.5	24.8	62.62	6.73	14.96	5.02	11.16	40.24	3.25	1.73	13.53
EC 3222	6	63.1	11.16	25	23.8	65.05	4.78	10.62	3.75	8.23	34.25	2.98	1.47	12.74
EC 323724	8	57.8	8.92	24	17.1	64.18	3.89	8.64	3.02	6.7	12.68	2.87	1.36	10.02
EC 323729	4.5	69.7	12.81	24	26.6	63.51	7.53	16.73	5.46	12.13	52	3.36	1.84	13.98
EC 386667	5.5	64.7	11.78	24.5	24.5	64.12	6.32	14.04	4.66	10.36	40.62	3.21	1.69	13.19
EC 386668	5	65.3	12.19	24	25.8	63.74	6.98	15.51	5.08	11.28	43.87	3.27	1.75	13.62
EC 99947	4	71.5	8.72	24.5	16	64	3.88	8.62	2.95	6.56	54.65	2.82	1.31	11.97
EC 107671	6	63.7	11.67	25	24.4	63.26	5.58	12.4	4.64	10.31	36.41	3.2	1.68	13.1
IC 313136	8	63.4	16.06	35.5	27.4	75	7.87	17.49	6.28	13.94	18.45	2.91	1.4	14.77
IC 313134	6	62	11.47	24.5	24.2	65.09	5.27	11.71	4.2	8.84	32.61	3.07	1.55	13.05
IC 274429	6	57.9	11.06	25	23.5	66.15	4.74	10.53	3.71	8.82	35.05	2.96	1.45	12.74
S. Em ±	0.43	4.11	0.63	1.25	1.32	3.41	0.29	0.617	0.18	37.58	2.4	0.15	0.09	0.78
C. D. (P = 0.05)	1.22	11.69	1.74	3.55	3.76	9.45	0.83	1.71	0.51	106.79	6.83	0.42	0.24	2.21

Table 2: Rutin content (mg/100g) of buckwheat (*Fagopyrum esculentum* Moench.) genotypes

S. No.	Genotypes	Rutin (mg/100g)
1	IC 313136	257.22
2	IC 79147	311.62
3	EC 323729	320.45
4	Rani chouri local 1	289.42
5	EC 386668	326.63
6	EC 286396	303.28
7	Sangla B 460	386.22
8	EC 386667	320.55
9	EC 107671	288.53
10	PRB 1	406.66
11	IC 313134	343.47
12	IC 49671	320.41
13	EC 104035	344.29
14	EC 218742	295.31
15	EC 3222	327.56
16	IC 274429	389.63
17	Shimla B 1	327.55
18	Nilgiri local	346.73
19	Sangla B 1	320.55
20	EC 125940	350.73
	S. Em ±	16.47
	C. D. (P = 0.05)	47.07

4. Conclusion

The buckwheat genotypes show considerable variation with respect to morphological, yield and quality traits. In the present study, the genotype IC 313136, IC 79147, EC 323729 and Rani chouri local 1 genotype have maximum seed yield, straw yield, protein and micronutrient content under northern dry zone of Karnataka. These genotypes will be further evaluated for morphological, grain yield and quality traits.

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