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RESEARCH PAPER

Response of buckwheat (*Fagopyrum esculentum* Moench.) genotypes to nutrient levels in vertisols of Northern Transition Zone of Karnataka

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Abstract: A field experiment was conducted to know the Response of buckwheat (*Fagopyrum esculentum* Moench.) genotypes to nutrient levels in vertisols of Northern Transition Zone of Karnataka at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad, Karnataka during *kharif* 2021. The experiment was laid out in a split plot design with three replications. The treatment consist of three genotypes *viz.,* G_1: Nilagiri (Dharwad selection-1), G_2: IC-79147 and G_3: PRB-1 in main plots and three fertilizer levels *viz.,* F_1:100% RDF (30:15:15 $N:P_2O_5:K_2O$ kg ha^{-1}), F_2: 125% RDF (37.5:18.75:18.75 $N:P_2O_5:K_2O$ kg ha^{-1}) and F_3: 150% RDF (45:22.5:22.5 $N:P_2O_5:K_2O$ kg ha^{-1}) allotted to sub plots. The results revealed that genotype IC-79147 recorded significantly higher yield attributes *viz.*, number of cluster plants^{-1} (13.29), number of grain clusters^{-1} (7.60), test weight (29.88 g) and grain yield (985 kg ha^{-1}). Genotype IC-79147 was on par with Nilagiri (Dharwad selection-1). Among the fertilizer levels, application of 150% RDF resulted in significantly higher growth parameters *viz.*, plant height (62.0 cm), total dry matter production per plant (5.38 g plant^{-1}), leaf area index (2.98) and higher yield attributes *viz.,* number of cluster plants^{-1} (13.35), number of grains clusters^{-1} (7.90), grain yield (1065 kg ha^{-1}) and straw yield (2083 kg ha^{-1}). Again, it remained on par with the application of 125% RDF. Among interaction effects, significantly highergrain yield (1131 kg ha^{-1}) and straw yield (2093 kg ha^{-1}) were observed with the application of 150% RDF with genotype IC-79147 and it was on par with 125% RDF with genotype IC-79147.

Key words: Buckwheat, Genotype, IC-79147, Pseudo cereal, Underutilized crops

Introduction

Buckwheat (*Fagopyrum esculentum* Moench*)* is an herbaceous erect annual plant with a diploid chromosomal number (2n=16) belongs to the Polygonaceae family. Buckwheat is one of the most significant pseudo cereal crops of the alpine region, widely planted between 1,800 and 4,500 m above mean sea level (MSL) during the *kharif* season in the middle and higher Himalayas. Buckwheat is a grain that evolved in the Central Asian temperate climate. Globally, buckwheat is grown over an area of 2.04 million hectares with a production of 2.4 million tonnes and having an average productivity of 1000 kg ha^{-1} (Anon., 2018). Buckwheat is primarily grown in the temperate zones of the Northern hemisphere, particularly in Russia (Oshini, 2004). It is grown in the United States, Canada, France, Germany,the United Kingdom, Denmark, Poland, the Netherlands, Sweden, Australia, Bulgaria, Romania, Italy, Japan, South Africa, Brazil, China, South Korea, Nepal and Bhutan. Buckwheat is grown for food and fodder purposes in Asian countries, including India, where the area and production are 60,000 ha and 30,000 tonnes, respectively (Anon., 2018).

Buckwheat is known in India by many other names, including ogal, phaphar and kuttu. Buckwheat is cultivated for its grain or nut-like fruits. Its grain is high in nutritional content, containing 52.11 per cent carbohydrate, 11-12.55 per cent protein, 8.7 per cent pulp, 2.23 per cent oil and 11 per cent water. Rutin content is 1.01, 0.32 and 1.36 percent in the leaf, stem and flower, respectively. The weight of 1,000 seeds is 24-30 g (Popovic *et al.,* 2013). It is used in a similar way as bread grain crops. Flavonoids are the most essential components of this plant (rutin). Grain also contains a significant number of essential amino acids, including lysine and methionine. Looking to it's value in terms of nutrients and health benefits there is need to produce the buckwheat to meet the demand of growing population which envisages the selection of suitable genotypes with optimum nutrient level.

Material and methods

A field experiment on response of buckwheat (*Fagopyrum esculentum* Moench.) genotypes to nutrient levels in vertisols of Northern transition zone of Karnataka was carried out at Main Agricultural Research Station (MARS), University of Agricultural Sciences, Dharwad, Karnataka during *kharif* 2021. The experimental site is located at 15^0 49' North latitude, 74^0 99' East longitude and 678 m above mean sea level (MSL). Soil of the experimental site is medium deep black clay loam in texture having a pH of 7.66, electrical conductivity of 0.25 dS m^{-1} and low in organic carbon content (0.45%) with low in available nitrogen (276.8 kg ha^{-1}), medium in available phosphorous (29.2kgha^{-1}) and high in available potassium (331.8 kg ha^{-1}). The experiment was laid out in split plot design with nine treatment combinations replicated three of the treatments consist of three genotypes *viz.*, G_1: Nilagiri (Dharwad selection-1), G_2: IC-79147 and G_3: PRB-1 in main plots and three fertilizer levels *viz.,* F_1:100% RDF (30:15:15 $N:P_2O_5:K_2O$ kg ha^{-1}),F_2:125% RDF (37.5:18.75:18.75 $N:P_2O_5:K_2O$ kg ha^{-1}) and F_3:150% RDF (45:22.5:22.5 $N:P_2O_5$: K_2O kg ha^{-1}) in sub plots were taken. Crop was sown during the *kharif* 2021 and full dose of NPK was applied at the time of sowing. The standard procedures are followed to record the biometric and yield observations. Leaf Area Index (LAI) was calculated by disc method as suggested by Sestak *et. al*. (1971).

Results and discussion

The results of the experiment revealed that (Table 3) the genotype IC-79147 recorded significantly higher grain yield (985 kg ha^{-1}) which was 12.69 per cent higher over Nilagiri (Dharwad selection-1). Significantly higher yield of genotype IC-79147) was mainly due to higher yield attributes namely, number of clusters plant^{-1}, number of grains clusters^{-1} and higher yield attributes are due genetic make of the genotype assisted to convert photosynthates from source to sink. On the contrary significantly higher straw yield was recorded with PRB-1 genotype (1912 kg ha^{-1}) which was 7.7 per cent higher as compared to IC-79147 (1831 kg ha^{-1}) and Nilagiri (Dharwad selection-1) (1774 kg ha^{-1}). This was due to the fact that genotype PRB-1 was highly responsive to nitrogen, phosphorus and potassium fertilizers and resulted in more vegetative growth, producing higher growth attributes such as plant height, number of leaves per plant, leaf area index and total dry matter production per plant as compared to other two genotypes (Table 1). Apart above the other reason may be better conversion of photosynthates from source to sink and lower harvest index. Similar results were observed by Maruti *et al.* (2018), Hulihalli and Shanthaveerayya (2017), Sharma V K (2005) and Hongmei *et al.* (2003).

Among the fertility levels, application of 150% RDF recorded significantly higher yield attributes (Table 2) *viz.,* number of clusters plants^{-1} (13.35), number of grains cluster^{-1} (7.90), grain yield (1065 kg ha^{-1}) and straw yield (2083 kg ha^{-1}). The grain yield was 28.63 per cent was higher over 100 per cent RDF and 150% RDF was on par with 125% RDF. Higher grain yield with 150% RDF was due to higher amount of nitrogen, phosphorus and potassium helped to enhance growth parameters such as plant height, leaf area index and total dry matter production per plant and yield attributes number of clusters plant^{-1} and number of grains cluster^{-1}. Better utilization of nutrients led to higher grain and straw yield (Table 1). Similar findings were made by Inamulla *et al.* (2012), Mahata (2016) and Maruti *et al.* (2018).

The genotype IC-79147 produced more yield (Table 2) attributes *viz.,* number of clusters plant^{-1}(15.01), number of grains cluster^{-1} (8.56) and grain yield (1131 kg ha^{-1}) with a fertility level of 150% RDF and was on par with genotype Nilagiri (Dharwad selection-1) with fertility level of 150% RDF with respect to number of clusters plants^{-1} (14.73), number of grain clusters^{-1} (8.02) and grain yield (1092 kg ha^{-1}) given in Table 2 and Table 3. The genotype with higher nitrogen availability made plants to give up higher number of yield attributing characters and potassium which might have helped in the translocation and accumulation of photosynthates from source to reproductive parts.The amount of buckwheat straw yield produced was directly influenced by the growth characteristics of the crop, such as plant height, the number of leaves per plant, the leaf area index and the accumulation of dry matter. The increased straw yield was due to the interaction effect of 45:22.5:22.5

Table 1. Plant height, number of leaves plant^{-1}, leaf area index and total dry matter of buckwheat as influenced by genotypes, fertilizer levels and their interaction effects

Treatment	Plant height (cm)	Number of leaves plant^{-1}	Leaf area index	Total dry matter (g plant^{-1})
Main plot (Genotypes)				
G_1	81.0^{b*}	16.70^{b}	2.04^{b}	6.50^{b}
G_2	83.7^{b}	16.95^{b}	2.40^{b}	8.26^{ab}
G_3	106.9^{a}	25.24^{a}	3.07^{a}	10.25^{a}
S.Em.±	2.07	0.36	0.05	0.35
Sub-plot (Fertilizer level)				
F_1	85.8^{b}	18.29^{b}	2.11^{b}	7.52^{b}
F_2	90.7^{ab}	19.43^{ab}	2.57^{a}	8.49^{ab}
F_3	96.0^{a}	21.16^{a}	2.83^{a}	9.01^{a}
S.Em.±	1.74	0.38	0.05	0.32
Interaction (G x F)				
G_1F_1	76.6^{d}	15.26^{e}	1.72^{g}	5.70^{f}
G_1F_2	79.8^{cd}	16.45^{de}	2.11^{ef}	6.78^{ef}
G_1F_3	89.1^{c}	18.38^{cd}	2.30^{de}	7.02^{ef}
G_2F_1	81.0^{cd}	15.52^{e}	1.82^{fg}	7.48^{def}
G_2F_2	83.2^{cd}	16.61^{de}	2.59^{cd}	8.31^{cde}
G_2F_3	87.8^{c}	18.73^{c}	2.78^{bc}	9.00^{bcd}
G_3F_1	100.7^{b}	24.10^{b}	2.80^{bc}	9.38^{abc}
G_3F_2	109.0^{ab}	25.24^{ab}	3.00^{b}	10.37^{ab}
G_3F_3	111.0^{a}	26.37^{a}	3.42^{a}	11.00^{a}
S.Em.±	3.21	0.64	0.09	0.57

*Means followed by same lower case letter/s in a column do not differ significantly by DMRT (P=0.05)

G: Genotypes G_1: Dharwad selection-1 F: Fertilizer levels (kg ha^{-1}) F_1: 100% RDF (30:15:15 N:P_2O_5:K_2O kg ha^{-1})
G_2: IC-79147 F_2: 125% RDF (37.5:18.75:18.75 N:P_2O_5:K_2O kg ha^{-1})
G_3: PRB-1 F_3: 150% RDF (45:22.5:22.5 N:P_2O_5:K_2O kg ha^{-1})

Table 2. Number of clusters plant^{-1}, number of grains cluster^{-1}and test weight of buckwheat as influenced by genotypes, fertilizer levels and their interaction effects

Treatment	Number of clusters plant^{-1}	Number of grains cluster^{-1}	Test weight (1000 seeds, g)
Main plot (Genotypes)			
G_1	12.61^{a}	7.22^{ab}	29.65^{a}
G_2	13.29^{a}	7.60^{a}	29.88^{a}
G_3	9.39^{b}	6.39^{b}	25.63^{b}
S. Em.±	0.29	0.15	0.35
Sub-plot (Fertilizer level)			
F_1	10.22^{b}	6.14^{b}	27.32^{a}
F_2	11.72^{ab}	7.17^{ab}	28.43^{a}
F_3	13.35^{a}	7.90^{a}	29.41^{a}
S.Em.±	0.31	0.20	0.40
Interaction (G x F)			
G_1F_1	10.33^{de}	6.21^{de}	28.61^{ab}
G_1F_2	12.77^{c}	7.42^{bc}	29.78^{a}
G_1F_3	14.73^{ab}	8.02^{ab}	30.56^{a}
G_2F_1	11.81^{cd}	6.46^{cde}	28.81^{ab}
G_2F_2	13.06^{bc}	7.78^{ab}	29.88^{a}
G_2F_3	15.01^{a}	8.56^{a}	30.95^{a}
G_3F_1	8.53^{e}	5.75^{e}	24.55^{c}
G_3F_2	9.32^{e}	6.30^{cde}	25.62^{c}
G_3F_3	10.31^{de}	7.12^{bcd}	26.72^{bc}
S.Em.±	0.53	0.32	0.67

*Means followed by same lower case letter/s in a column do not differ significantly by DMRT (P=0.05)

G: Genotypes — F: Fertilizer levels (kg ha^{-1})
G_1: Dharwad selection-1 — F_1: 100% RDF (30:15:15 $N:P_2O_5:K_2O$ kg ha^{-1})
G_2: IC-79147 — F_2: 125% RDF (37.5:18.75:18.75 $N:P_2O_5:K_2O$ kg ha^{1})
G_3: PRB-1 — F_3: 150% RDF (45:22.5:22.5 $N:P_2O_5:K_2O$ kg ha^{-1})

Table 3. Grain yield, straw yield and harvest index of buckwheat as influenced by genotypes, fertilizer levels and their interaction effects

Treatment	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index (%)
Main plot (Genotypes)			
G_1	940^{ab*}	1774^{b}	34.61^{b}
G_2	985^{a}	1831^{a}	34.95^{a}
G_3	860^{b}	1912^{a}	30.97^{b}
S.Em.±	16.4	25.6	0.69
Sub-plot (Fertilizer level)			
F_1	760^{b}	1528^{b}	33.23^{a}
F_2	959^{a}	1907^{a}	33.48^{a}
F_3	1065^{a}	2083^{a}	33.82^{a}
S.Em.±	34.8	65.3	1.30
Interaction (G x F)			
G_1F_1	770de	1467^{c}	34.41^{a}
G_1F_2	959^{a-d}	1808^{a-c}	34.65^{a}
G_1F_3	1091^{ab}	2049^{a}	34.77^{a}
G_2F_1	801^{c-e}	1506^{c}	34.73^{a}
G_2F_2	1022^{ab}	1895^{ab}	35.03^{a}
G_2F_3	1131^{a}	2093^{a}	35.08^{a}
G_3F_1	708^{e}	1610^{bc}	30.55^{a}
G_3F_2	897^{b-e}	2019^{a}	30.75^{a}
G_3F_3	974^{a-c}	2107^{a}	31.61^{a}
S.Em.±	51.9	95.9	1.97

*Means followed by same lower caseletter/s in a column do not differ significantly by DMRT (P=0.05)

G: Genotypes — F: Fertilizer levels (kg ha-1)
G_1: Dharwad selection-1 — F_1: 100% RDF (30:15:15 $N:P_2O_5:K_2O$ kg ha-1)
G_2: IC-79147 — F_2: 125% RDF (37.5:18.75:18.75 $N:P_2O_5:K_2O$ kg ha1)
G_3: PRB-1 — F_3: 150% RDF (45:22.5:22.5 $N:P_2O_5:K_2O$ kg ha-1)

$N:P_2O_5$: K_2O kg ha^{-1} and PRB-1 genotype, which was comparable to G_3F_2, G_2F_3, G_2F_3 and G_1F_3 was highly responsive to available nutrients in the soil, resulting in higher growth parameters and which led to high straw yield and the results are in confirmation with the findings of Christensen *et al.* (2007) and Hongmei *et al.* (2003).

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