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Effect of different sowing dates and fertility levels on growth, yield and quality of buckwheat (*Fagopyrum esculentum*) in northern hills of Chhattisgarh

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Abstract

A field experiment was conducted at Potato and Temperate Fruit Research Station, Mainpat, Ambikapur, Chhattisgarh during 2023-24 *Rabi* season to find out the suitable sowing dates and direct effect of different fertility levels on buckwheat. The trial was laid out in split plot design with three dates of sowing viz. 2nd week of September (D₁), 3rd week of September (D₂) and 4th week of September (D₃) as main-plot treatment and three fertility levels viz. 60:50:40 kg NPK ha⁻¹ (F₁), 50:40:30 NPK kg ha⁻¹ (F₂) and 40:30:20 NPK kg ha⁻¹ (F₃) as sub-plot treatment. Results showed that growth parameters viz. plant population, plant height, number of primary branches plant⁻¹, number of leaves plant⁻¹, dry matter accumulation, and all yield attributing characters were the highest under 2nd week of September (D₁). The highest grain yield (7.25 q ha⁻¹), straw yield (11.06 q ha⁻¹), net return returns (₹25771.89 ha⁻¹) and B:C ratio (1.47) were noted with crop sown on 2nd week of September (D₁). Among the different fertility levels, application of 60:50:40 NPK kg ha⁻¹ (F₁), was found superior over 50:40:30 NPK kg ha⁻¹ (F₂), and 40:30:20 NPK kg ha⁻¹ (F₃), with respect to growth performance and yield attributes which produced significantly highest grain yield (7.0 q ha⁻¹), straw yield (10.71 q ha⁻¹), net returns (Rs. 20862 ha⁻¹) and B:C ratio (1.11). The interaction effect between sowing dates and fertility levels was found significantly on dry matter accumulation after 60 DAS and flour percentage.

Keywords: Buckwheat (*Fagopyrum esculentum*), sowing dates, fertility levels, growth and yield, quality parameters, northern hills of Chhattisgarh, split plot design, agronomic performance

Introduction

Buckwheat, scientifically known as *Fagopyrum esculentum* (Moench, 2n=16), is a pseudo cereal crop belongs to the Polygonaceae family. In Hindi, it is called "Kutu". Formerly referred to as an underutilized crop, the crop is now recognized as a "potential crop" or "future crop" (Yadav *et al.* 2017) [11] as it can be grown in diverse climatic conditions. This plant is believed to have originated in Temperate Central Asia, with China being considered as center of origin of buckwheat (Farooq *et al.* 2016) [1]. Buckwheat holds significant agricultural importance in mountainous regions with elevations above 1800m, serving as a crucial crop for both grains and greens. Buckwheat grains typically have a protein content of 10-15%, which is higher than that of most other cereals. The early as well as late planting of buckwheat influences the growth and yield due to change in the climatic conditions which are responsible for change in the time of vegetative, reproductive and maturity stages of buckwheat. Fertilizer is another important input for any crop. Different NPK dose significantly affect the yield and quality of the produce. buckwheat is a crop for soils with low fertility (Rana *et al.*, 2003) [6]. It needs very few nutrients (Radics and Mikohazi, 2010) [5]. Buckwheat has a phosphorus (P) absorption that is almost ten times greater than wheat's (Zhu *et al.*, 2002) [12]. For a larger grain yield, buckwheat has to have both N and P applied simultaneously (Saqib *et al.*, 2012) [9]. The maximum yield potential is limited by the uneven and insufficient application of macronutrients as well as the low soil organic matter content (Tandon, 1992) [10].

Materials and Methods

The field experiment was conducted to study “Effect of different sowing dates and fertility levels on growth, yield and quality of buckwheat (*Fagopyrum esculentum*) in northern hills of Chhattisgarh” during Rabi season 2023-24 at the Potato Research Station, Mainpat, Ambikapur, Chhattisgarh which is located the northern region of Chhattisgarh, with an elevation of 1085 meters above mean sea level. It is situated between 22°83' N latitude and 83°31' E longitude. The soil of the experimental field was slightly acidic in nature having pH 6.23. The experiment was laid out in split plot design consisting of 09 treatments replicated three times. The treatments comprised of three dates of sowing viz. 2nd week of September (D1), 3rd week of September (D2) and 4th week of September as main-plot treatment and three fertility levels viz. 60:50:40 kg NPK ha⁻¹ (F1), 50:40:30 NPK kg ha⁻¹ (F2) and 40:30:20 NPK kg ha⁻¹ (F3) as sub-plot treatment. The local variety of buckwheat was used. The crop was sown on 14th September, 21st September and 30th September in 2023. The crop received recommended dose of nitrogen, phosphorus and potash through urea, SSP and muriate of potash, respectively. The whole amount of phosphate and potash and nitrogen was applied as basal dose at time of sowing. Plant sample of seed of buckwheat collected at harvest and were milled with the help of stone mill and sieved properly to separate the husk. The weight of flour was recorded on an electronic balance and flour percentage was calculated. The protein content of grain was calculated for treatment by multiplying nitrogen content with the conversion factor of 6.25.

Results and Discussion Growth Parameters

Plant growth parameters viz., plant height, dry matter accumulation plant⁻¹ at harvest stage and number of primary branches plant⁻¹ at 60 DAS was significantly affected by date of sowing and different fertility levels (Table 1). Sowing of buckwheat on 2nd week of September (D1) recorded significantly taller plant height (110.07cm), number of primary branches plant⁻¹ (6.18) and dry matter accumulation plant⁻¹ (7.96 g) as compared to other treatments. This might be because the buckwheat plant has adequate access to growth-promoting elements including sunshine, moisture, and nutrients. Similar finding was also recorded by Patel *et al.* (1999) [4]. The shortest plant height, low primary branches plant⁻¹ and dry matter accumulation plant⁻¹ of buckwheat recorded when crop sown on 4th week of September (D3). Buckwheat that was sown later than other crops germinated later and grew more slowly because of the low temperatures that occurred during the early growth phase. With respect different fertility levels, application of 60:50:40 kg NPK ha⁻¹ (F1) recorded significantly taller plants (102.81cm), number of primary branches plant⁻¹ (6.11) and dry matter accumulation plant⁻¹ (7.7g) as compared to other treatments. Almost similar results have also been reported by Hulihalli *et al.* (2018) [3] and Rana *et al.* (2003) [6]. Important nutrients like N, P, and K are easily accessible to plants in their early phases of growth, thus it is probable that the increasing trend in morphological parameters is the consequence of fertilizers being administered at the recommended dosage.

Table 1: Plant growth parameters of buckwheat as influenced by different sowing dates and fertility levels

Treatments	Plant height (cm)	Number of primary branches plant ⁻¹	Dry matter accumulation plant ⁻¹ (g)
Date of sowing			
D ₁ - 2nd week of September	110.07	6.18	7.96
D ₂ - 3rd week of September	99.81	5.41	7.46
D ₃ - 4th week of September	92.70	4.04	7.08
SEm±	1.36	0.19	0.10
CD (P = 0.05)	5.34	0.73	0.40
Fertility levels (NPK kg ha⁻¹)			
F ₁ - N ₆₀ P ₅₀ K ₄₀	102.81	6.11	7.70
F ₂ - N ₅₀ P ₄₀ K ₃₀	101.30	5.37	7.50
F ₃ - N ₄₀ P ₃₀ K ₂₀	98.48	4.15	7.30
SEm±	1.00	0.22	0.05
CD (P = 0.05)	3.07	0.69	0.14

Yield attributes and yield

Data presented in Table 2, revealed that seeds plant⁻¹, seed weight plant⁻¹, 1000 seed weight, seed yield and straw yield as significantly influenced by date of sowing and different fertility levels. Among the date of sowing, crop sown on 2nd week of September (D1) was recorded significantly maximum number of seeds plant⁻¹ (97.22), seed weight plant⁻¹ (3.44 g), 1000 seed weight (23.23 g), grain yield (7.25 q ha⁻¹) and straw yield (11.06 q ha⁻¹) compared to rest of treatments. Early planting caused more vigorous development, which in turn caused more photosynthates to be translocated from leaves to the reproductive sections, which is why yield attributes increased so quickly. Gubbels (1978) [2] also observed that seed size of buckwheat increased with increased soil moisture content. Yield variations between sowing dates may be caused by increased dry matter production in addition to other yield factors. Among different fertility levels, application of 60:50:40: NPK kg ha⁻¹ (F1) produced significantly maximum number of seeds plant⁻¹ (93.22), seed weight plant⁻¹ (3.06 g), 1000 seed weight (22.85 g), grain

yield (7 q ha⁻¹) and straw yield (10.71 q ha⁻¹) compared to other nutrient levels. Greater NPK fertilization improved the amount of carbohydrates as absorption enhanced the yield-related characteristics (number of clusters and number of seeds per cluster) when there was an adequate supply of fertilizers. The crop produced more growth and growth-attributing characteristics when it had access to more nutrients. The above results are in line with the findings of Salmankhan *et al.* (2021) [8] in buckwheat and Maruti *et al.* (2018) [3].

Protein content (%)

Protein content in buckwheat grain was unaffected by date of sowing (Table 2). Among different fertility levels, Protein content (13.03 %) was higher under 60:50:40: NPK kg ha⁻¹ (F1) and it recorded lowest values (12.88%) under 40:30:20 NPK kg ha⁻¹ (F3). Rathiya (2020) [7] stated that protein content has linear relation with nitrogen content of buckwheat grain and protein content and yield showed an increasing trend with increasing fertility level.

Table 2: Yield attributes, yield and protein content (%) of buckwheat as influenced by different sowing dates and fertility levels

Treatment	Number of seeds plant-1	Seed weight plant-1 (g)	1000 seed weight (g)	Grain yield (q ha-1)	Straw yield (q ha-1)	Protein content (%)
Date of sowing						
D ₁ -2 nd week of September	97.22	3.44	23.33	7.25	11.06	13.15
D ₂ - 3 rd week of September	90.22	2.79	22.54	6.82	10.45	12.97
D ₃ - 4 th week of September	83.22	2.30	21.28	6.14	9.69	12.73
SEm±	1.17	0.09	0.21	0.08	0.09	0.09
CD(P=0.05)	4.59	0.36	0.83	0.33	0.36	NS
Fertility levels (NPK kg ha-1)						
F ₁ -N60P50K40	93.22	3.06	22.85	7.00	10.71	13.02
F ₂ - N50P40K30	89.44	2.79	22.42	6.71	10.33	12.94
F ₃ -N40P30K20	88.00	2.66	21.88	6.50	10.17	12.88
SEm±	1.18	0.09	0.31	0.09	0.08	0.02
CD(P=0.05)	3.64	0.28	NS	0.28	0.23	0.06

Economics

Net return and B:C ratio of buckwheat as affected by date of sowing and different fertility levels (Table 3). With respect to date of sowing, maximum net returns (₹25771.89 ha⁻¹) and B:C (1.47) was obtained when crop sown on 1st week of October (D₁) compared to rest of treatments. The higher value for D₁ indicates that buckwheat effectively used the soil

moisture at the right time sowing, which ultimately results in a better yield. This is because the yield component of timely planted crops is better expressed, ultimately recording higher production potential along with good monetary return. Among fertility levels 60:50:40: kg NPK ha⁻¹ (F₁) recorded higher net return (₹20862.59) and B.C ratio (1.11) followed by 50:40:30 kg NPK ha⁻¹.

Table 3: Economics of buckwheat as influenced by different sowing dates and fertility levels

Treatment	Cost of cultivation (₹ ha-1)	Net return (₹ ha-1)	B: C ratio
Date of sowing			
D ₁ -2 nd week of September	17519.22	25771.89	1.47
D ₂ - 3 rd week of September	17519.22	18835.78	1.07
D ₃ - 4 th week of September	17519.22	12700.23	0.72
SEm±	-	113.73	0.01
CD (P= 0.05)	-	446.54	0.03
Fertility levels (NPK kg ha-1)			
F ₁ - N60P50K40	18847.41	20862.59	1.11
F ₂ - N50P40K30	17519.22	19086.34	1.09
F ₃ -N40P30K20	16191.03	17358.97	1.07
SEm±	-	276.33	0.02
CD (P= 0.05)	-	851.46	NS

Conclusions

Based on the thesis results, it can be concluded that maximum and profitable yield of buckwheat secured by sowing on 2nd week of September and using the fertilizer dose of 60:50:40 kg NPK ha⁻¹ under prevailing agro climatic conditions.

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