



Impact of Land Configuration and Nutrient Management Practices on Growth and Yield Attributes of Black Gram (*Vigna mungo* L.) and Wheat (*Triticum aestivum* L.) Cropping System

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ABSTRACT

Background: Wheat and black gram both are important crops in India and both crops are well known for their nutritional values. Wheat and black gram face some problems while cultivation like water-logging in wheat and water stagnation in blackgram. These can be resolved by adopting the effective land configuration and nutrient management techniques. By keeping this view, the field experiment was conducted to evaluate the effect of land configuration and nutrient management on performance of black gram and wheat.

Methods: A field experiment was conducted during *kharif* and *rabi* season of 2023 and 2024 on sandy loam soil at Lovely Professional University, Phagwara, Punjab, to evaluate the impact of land configuration and nutrient management practices on growth and yield attributes of black gram (*Vigna mungo* L.) and wheat (*Triticum aestivum* L.) cropping system. The treatments comprised of three land configurations (Flat line sowing, Raised bed (67.5 cm) and Broad bed (105 cm) as main plot and six nutrient management options (100% RDF, 100% RDF with seed inoculation, 100% nitrogen through FYM, 100% nitrogen through FYM with seed inoculation, 50% NPK through fertilizer + 50% nitrogen through FYM, 50% NPK through fertilizer + 50% nitrogen through FYM with seed inoculation) as sub plot. The design of experiment was split plot with three replications.

Result: The results discovered that raised bed raises the growth and yield of the black gram as well as wheat grown in sequence as compared to flatbed method. In nutrient management, 50% NPK + 50% N (FYM) with seed inoculation treatment combination was noticed highest values of all the growth and yield attributing parameters of black gram and succeeding wheat than other treatments.

Key words: Consortia, FYM, Land configuration, Nutrient management, Rhizobium.

INTRODUCTION

Among all legume crops and all pulses, black gram is an important pulse crop. It is mostly consumed in India, Thailand and other tropical nations worldwide (Pandey *et al.*, 2018). The origin of black gram is India (Venkidasamy *et al.*, 2019). Black gram is a significant short-term pulse crop commonly planted in both *kharif* and *rabi* seasons in India (Banerjee *et al.*, 2021). According to the report of the Agriculture Market Intelligence Centre, PJTSAU 2023-2024, India is the world's leading producer of black gram, accounting for 70% of the total production. Black gram (*Vigna mungo*) is a self-pollinated crop. Generally, it is known as urd bean but called by different names in various states and other nations' languages. It includes sulphur, which is a good source of amino acids like methionine, cysteine and lysine, which are necessary for a balanced diet for humans. Black gram is a small and black-colored bean widely used to make many food items and cuisines. Black gram is an extremely nutritious grain legume crop. Black gram is known for its high content of protein and it varies from 24%- 28% (Venkidasamy *et al.*, 2019). But the availability of pulses decreases despite the increase in production of pulses because of the gap in production and the demand of the country of pulses (Singh *et al.*, 2025a). Pulses possess the ability to convert atmospheric nitrogen into a usable form, thereby enhancing soil fertility and overall

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soil health; cultivating pulses also supports sustainable agricultural practices and lowers greenhouse gas emissions (Abd-Alla *et al.*, 2023).

Triticum aestivum L., commonly known as wheat, ranks as the world's most significant cereal crop after rice. This food is consumed in numerous forms and serves as a staple food of diets globally (Lateif *et al.*, 2024). In India, wheat straw serves as a suitable source of nutrition for a higher population of cattle. Globally, it is majorly grown in countries like China, India, Russia and United states, with production of approximately 770 million metric tons

annually. India is the second-highest wheat-producing country in the world after China. Wheat is premier cereal in Punjab in *rabi* season (FAO, 2023).

Integrated nutrient management (organic fertilizers like FYM, biofertilizers combined with inorganic fertilizers) is the best option of nutrient management as per various studies (Samant and Mishra, 2023). For the black gram nitrogen-fixing *Rhizobium* inoculation has been reported to enhance the biomass accumulation and grain yield (Virk *et al.*, 2024). The main reasons for poor crop yields and substandard crop quality were the adoption of inadequate nutrient management methods Singh *et al.*, 2025b. Indian soils are predominantly lacking in nitrogen content. At a global level, nitrogen is the nutrient that most restricts crop yields (Singh *et al.*, 2023). Nitrogen is essential for healthy growth in most crops during their initial vegetative phase and nitrogen management is a crucial factor for boosting crop productivity and profitability in dry climates, as stated by Amanullah *et al.* (2015).

Enhancing agricultural yield and input utilization efficiency is largely dependent on the layout of the land and proper fertilizer control. The method by which the land is ready for agricultural planting is referred to as land configuration. Land configuration refers to the arrangement of land and its features. Raised beds, ridge and furrow, flat bed and broad bed furrow systems are some of the

techniques that it comprises (Khan *et al.*, 2020). Raised beds may aid in moisture conservation and availability for a comparatively longer period of time in rainfed circumstances (Singh *et al.*, 2025). In the areas with heavy rainfall, ridges may aid in draining surplus water from the crop root zone, improving soil warmth, aeration and nutrient availability, as well as increasing the crop root zone's depth and resolving the issues of lodging and water stagnation (Babu *et al.*, 2020). There is no more information about the land configuration with different integrated nutrient management system. The study aims to assess the impact of land configuration and nutrient management on resource use efficiency, while also promoting sustainable agricultural practices in black gram and wheat cropping systems.

MATERIALS AND METHODS

The study was conducted at the farm of Lovely Professional University, Phagwara (Punjab) during the *kharif* season (July-September) of 2023 and *rabi* season (November to April) 2023-24 to evaluate the "Effect of land configuration and nutrient management system on growth and yield attributes of black gram (*Vigna mungo* L.) and wheat (*Triticum aestivum* L.) cropping system". The experimental site falls under the subtropical category and the weather data recorded during the *kharif* and *rabi* season of year 2023-2024 are mentioned in the Fig 1 and Fig 2. The soil

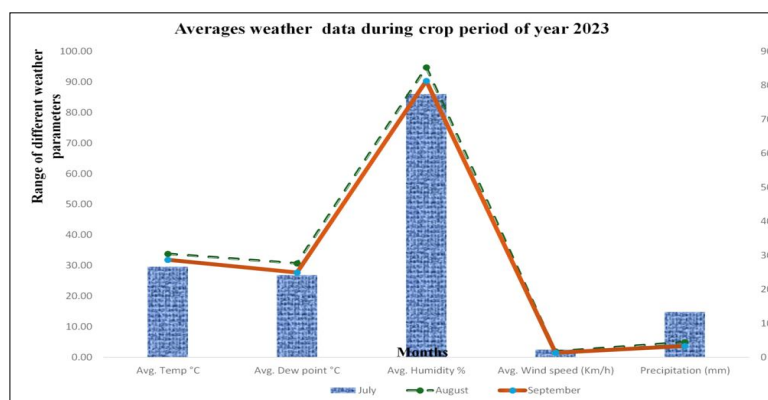


Fig 1: Weather data during black gram crop period of year 2023.

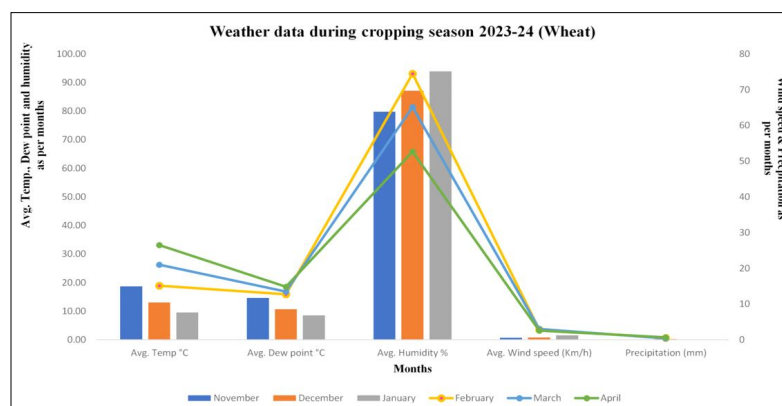


Fig 2: Weather data during wheat crop period of year 2023-24.

samples were collected from 10 different locations of allocated field randomly with the help of auger from the depth of 15 cm. These samples were further used for analysis to determine the physicochemical properties and soil fertility status. The allocated field was having sandy loam soil with low organic carbon (0.20%) and available nitrogen (221.3 kg ha^{-1}), moderately high available phosphorus (27.9 kg ha^{-1}) and high available potassium (180.7 kg ha^{-1}). The soil was nearly neutral with pH of (7.6) and electrical conductivity of ($0.205 \text{ mmhos cm}^{-1}$).

The experiment was set up in three replications using the split plot design with 3 main plots and 6 subplots. The main plot of the study was the land configuration (Flat line sowing), Raised bed (67.5 cm), Broad Bed (105 cm) and the subplot was the nutrient management comprises of (100% RDF, 100% RDF with inoculation, 100% N (FYM), 100% N (FYM) with inoculation, 50% NPK + 50% N (FYM), 50% NPK + 50% N (FYM) with inoculation. The seeds were inoculated with biofertilizers as per treatments, for black gram *Rhizobium* liquid (5 ml kg^{-1} seed) was used and for wheat *Consortia* liquid (IFFCO) (5 ml kg^{-1}) was used. For black gram, Mash 1008 and for wheat, DBW 222 variety was used that was procured from local seed shop. The inoculated and inoculated seeds were dibbled manually in net plot area of (1620 m^2) with spacing followed ($30 \text{ cm} \times 15 \text{ cm}$ for black gram) (22.5 cm for wheat) as per the treatments. FYM was incorporated with last plough as per treatments. One pre-sowing irrigation was applied to the field seven days before sowing followed by a post-sowing irrigation about 9-11 days after sowing. For data collection of growth parameters, from each plot five randomly chosen plants were tagged. The yields were recorded from net plot area and converted in to kilograms per hectare. The plant height was measured with measuring tape and chlorophyll value was taken with the help of SPAD meter. The crop was harvested with sickle, tied and tagged in bundles which was later threshed after sun drying, for the estimation of after harvest data collection of crops like seed and stover yield of the crop. All the cultivation operations were performed manually plot-wise during the crop season. The growth parameters viz., plant height (cm), number of branches plant^{-1} , number of leaves plant^{-1} and dry matter (g plant^{-1}) were recorded for black gram and for growth parameters of wheat the data of plant height (cm), number of tillers and dry matter accumulation. Whereas, yield attributing characters, grain yield (q ha^{-1}) and straw yield (q ha^{-1}) were recorded at the time of harvesting of black gram as well as wheat.

Statistical method

The data obtained from various characters under study were analyzed by the method of analysis of variance as described by (Gomez and Gomez, 1984). The ANOVA and critical difference at five per cent level of significance were calculated. Analysis was done by using OPSTAT software.

RESULTS AND DISCUSSION

Impact of land configuration and nutrient management on black gram

Growth parameters of black gram

Growth parameters such as plant height, number of leaves, number of branches and dry matter accumulation (g) were significantly influenced by land configuration and nutrient management practices. Significantly higher plant height (34.64 cm), number of leaves (14.13), number of branches (13.02) and dry matter accumulation (27.82 g) was recorded under raised bed at harvesting stage as compared to broad bed (Table 1) and lowest value were recorded in flat bed system. It was probably due to improved drainage and aeration, resulting in higher growth attributes recorded in raised bed than flat beds (Rathore *et al.*, 2010). There was observed, plant height (7.14%), number of leaves (18.5%), number of branches (18.47%), dry matter (5.53%) under the raised bed system compared to flatbed system. Among nutrient management practices, 50% NPK + 50% N FYM with seed inoculation treatment has recorded maximum growth attributes of black gram at harvesting stage, but treatment 50% NPK + 50% N through FYM was at par with 50% NPK + 50% N FYM with seed inoculation. An integrated approach has been found to balance nutrient supply and improve soil health as well as crop performance (Umesh *et al.*, 2024). The enhanced growth of black gram with the use of fertilizers can likely be attributed to their crucial involvement in several key physiological and biochemical processes, namely, root development, photosynthesis, energy transfer reactions and the symbiotic biological nitrogen fixation process. (Singh *et al.*, 2023a; Manjeet *et al.*, 2023).

Yield and yields attributes of black gram

The yield and yields attributes of black gram were varied significantly due to different land configuration and nutrient management. Highest grain yield was recorded under raised bed (6.85 q ha^{-1}) planting which was significantly superior over broad bed planting and nutrient management, application of 50% NPK + 50% N FYM combination recorded (Table 2) significantly higher grain yield among the rest of treatments. It might be due to better utilization nutrients and space, resulted higher yield attributes (pods plant^{-1} , pod length, number of seeds pod^{-1}) was occurred. The increase in number of pods in raised bed system might be because of proper growth of the crop which further resulted in better translocation of food material to reproductive part of the plant. Same trends were followed in stover yield. There was positive interaction recorded between land configuration and nutrient management in terms of plant height, dry matter (Table 1), seed and stover yield of the blackgram (Table 2). These results confirm the finding of (Pandey *et al.*, 2018).

Table 1: Land configuration and nutrient management system influence on growth attributes of black gram.

Treatments	Plant height (cm)	No. of leaves plant ⁻¹	Dry wt. accumulation (g)	No. of branches plant ⁻¹
Factor A				
L1	32.33	11.92	26.36	10.99
L2	34.64	14.13	27.82	13.02
L3	33.73	13.09	26.97	11.72
Sem±	0.15	0.15	0.19	0.85
CD (0.05)	0.59	0.62	0.78	NS
Factor B				
N1	33.05	12.79	26.62	11.86
N2	34.26	13.78	27.43	12.30
N3	30.42	10.11	24.44	8.69
N4	32.94	11.64	26.24	11.65
N5	34.76	14.49	27.98	12.66
N6	35.95	15.48	29.60	14.29
Sem±	0.18	0.35	0.19	0.15
CD (0.05)	0.51	1.01	0.54	0.43
Interaction A×B				
Sem±	0.43	0.89	0.54	0.73
CD (0.05)	0.99	NS	1.26	NS

Here in tables L1 used for Flat line sowing, L2 for Raised bed of 67.5 cm width and L3 for Broad bed (105 cm) respectively as a main factors of land configuration, the sub factors of Nutrient management represent with 'N' like N1 = 100% RDF, N2 = 100% RDF with inoculation, N3 = 100% N (FYM), N4 = 100% N (FYM) with inoculation, N5 = 50% NPK + 50% N (FYM), N6 = 50% NPK + 50% N (FYM) with inoculation.

Table 2: Yield and yield attributes of black gram as influenced by land configuration and nutrient management system.

Treatments	Pod length (cm)	No. of pods plant ⁻¹	No. of seeds pod ⁻¹	Seed yield (q ha ⁻¹)	Stover yield (q ha ⁻¹)
Factor A					
L1	4.283	20.68	3.56	6.15	16.58
L2	5.277	21.68	4.64	6.85	18.80
L3	4.623	21.21	4.06	6.48	17.74
Sem (±)	0.611	0.20	0.31	0.06	0.05
CD (0.05)	NS	NS	NS	0.25	0.21
Factor B					
N1	4.404	21.38	3.66	4.94	15.39
N2	4.763	21.82	4.16	5.37	16.45
N3	3.797	17.01	2.96	6.12	17.49
N4	4.018	20.89	3.28	6.90	18.25
N5	5.142	22.42	4.65	7.52	18.95
N6	6.243	23.61	5.82	8.10	19.70
Sem (±)	0.151	0.23	0.16	0.07	0.12
CD (0.05)	0.437	0.66	0.46	0.19	0.34
Interaction A×B					
Sem (±)	0.3	0.56	0.39	1.04	2.89
CD (0.05)	NS	NS	NS	2.18	6.11

Here in tables L1 used for Flat line sowing, L2 for Raised bed of 67.5 cm width and L3 for Broad bed (105 cm) respectively as a main factors of land configuration, the sub factors of Nutrient management represent with 'N' like N1 = 100% RDF, N2 = 100% RDF with inoculation, N3 = 100% N (FYM), N4 = 100% N (FYM) with inoculation, N5 = 50% NPK + 50% N (FYM), N6 = 50% NPK + 50% N (FYM) with inoculation.

Table 3: Land configuration and nutrient management system influence on growth and growth attributes of wheat.

Treatments	Plant height (cm)	No. of tillers m ²	Dry wt. accumulation (g)
Factor A			
L1	105.35	99.12	211.92
L2	107.07	100.92	215.68
L3	106.49	99.91	213.45
SEm (±)	0.27	0.18	0.59
CD (0.05)	1.10	0.71	2.38
Factor B			
N1	106.81	103.02	218.84
N2	107.46	104.02	219.72
N3	99.56	81.12	184.71
N4	106.76	100.87	216.90
N5	107.95	104.65	220.32
N6	109.25	106.20	221.62
SEm (±)	0.28	0.15	0.53
CD (0.05)	0.81	0.43	1.55
Interaction A×B			
SEm (±)	0.67	2.40	1.43
CD (0.05)	NS	9.39	3.24

Here in tables L1 used for Flat line sowing, L2 for Raised bed of 67.5 cm width and L3 for Broad bed (105 cm) respectively as a main factors of land configuration, the sub factors of Nutrient management represent with 'N' like N1 = 100% RDF, N2 = 100% RDF with inoculation, N3 = 100% N (FYM), N4 = 100% N (FYM) with inoculation, N5 = 50% NPK + 50% N (FYM), N6 = 50% NPK + 50% N (FYM) with inoculation.

Effect of land configuration and nutrient management on wheat

Growth attributes of wheat

Growth parameters of wheat such as plant height, number of tillers and dry matter accumulation were significantly affected with land configuration and nutrient management practices which is shown in Table 3. Significantly higher growth was recorded in raised bed with the combination of 50% NPK + 50% N FYM with seed inoculation as compare to other treatments. This might be due to better availability of nutrients and resources to crop as per the finding of Tomar *et al.* (2016).

Yield and yield attributes of wheat

According to the data (Table 4), the number of spikes per plant of wheat was highest when wheat was sown on raised bed and 50% NPK + 50% N FYM with seed inoculation produced the maximum number of spikes per plant, due to better nutrient and space utilization, which resulted in the highest number of effective tillers and caused the maximum number of spikes per plant. The increased number of spikes in the raised bed might be attributed to optimal crop growth, which resulted in enhanced transfer of food material to the plant's reproductive parts. Yield per hectare varied greatly depending on field design and fertilizer management choices (Table 4). The highest grain production was recorded under raised bed system, which was considerably superior to broad bed system. It might be due to owing to greater yield attributes (spike length and number of grains spike⁻¹). The high grain yield in this experiment was primarily due to the plant being able to collect and transport

Table 4: Yield and yield attributes of wheat as influenced by land configuration and nutrient management system.

Treatments	Spike length (cm)	No. of grains spike ⁻¹	Grain yield (q ha ⁻¹)	Straw yield (q ha ⁻¹)
Factor A				
L1	10.45	41.39	50.67	57.25
L2	11.46	42.42	51.36	67.58
L3	10.88	41.82	50.68	67.01
SEm (±)	0.29	0.29	0.02	0.11
CD (0.05)	NS	NS	0.10	0.44
Factor B				
N1	10.43	42.31	56.76	55.54
N2	10.87	42.75	56.76	74.69
N3	10.20	36.45	21.59	74.72
N4	9.94	41.82	56.75	29.27
N5	11.47	43.35	56.77	74.72
N6	12.66	44.54	56.78	74.74
SEm (±)	0.02	0.03	0.04	0.15
CD (0.05)	0.07	0.09	0.13	0.43
Interaction A×B				
SEm (±)	0.70	0.29	3.72	1.12
CD (0.05)	NS	1.18	8.82	4.64

Here in tables L1 used for Flat line sowing, L2 for Raised bed of 67.5 cm width and L3 for Broad bed (105 cm) respectively as a main factors of land configuration, the sub factors of Nutrient management represent with 'N' like N1 = 100% RDF, N2 = 100% RDF with inoculation, N3 = 100% N (FYM), N4 = 100% N (FYM) with inoculation, N5 = 50% NPK + 50% N (FYM), N6 = 50% NPK + 50% N (FYM) with inoculation

photosynthates from the source to the sink more effectively under optimal soil conditions, resulting in enhanced all growth and yield attributes. There was recorded positive interaction between land configuration and nutrient management in terms of number of tillers dry matter accumulation (Table 3) and growth attributes of wheat crop (Table 4) Jadhav *et al.* (2022) reported similar results.

CONCLUSION

As per the study's results, it can be concluded that raised bed (67.5 cm) among land configuration techniques performed well by achieving highest growth and yield in black gram- wheat cropping system. In case of nutrient management, -the application of 50% NPK + 50% N (FYM) with seed inoculation resulted in enhanced growth and yield of black gram and wheat. This approach is recommended to the farmers of the better performance of crops, in the areas where higher rainfall received.

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Disclaimers

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Conflict of interest

The authors declare that there is no competing interest.

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