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Exploring the potential of soybean as an intercrop in maize-based cropping systems

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INTRODUCTION & AIM

Maize is the third most important crop globally, following rice and wheat, and accounts for over half of food consumption in developing nations. Nutritionally, maize contains 68.5% carbohydrates, 16.5% protein, 8% lipids, and other essential nutrients. However, intensive cropping practices deplete soil fertility, reduce productivity, and increase input requirements.

In Pakistan, traditional farming is labor-intensive and exacerbates soil degradation, failing to meet farmers' needs. To sustain production and soil fertility, maize-soybean intercropping offers a promising solution. Soybean, as a legume, fixes atmospheric nitrogen, enhances soil fertility, improves fodder quality, and serves as a biofuel crop. Additionally, soybean intercropping can help bridge the significant gap in Pakistan's edible oil supply.

Maize-soybean intercropping, particularly with brown manuring, enriches soil nitrogen through N2 fixation, retains moisture, and provides mulch, reducing reliance on synthetic fertilizers. Fodder intercropping increases silage yield, dry matter, and nutrient content, making it ideal for livestock nutrition. Despite these benefits, soybean cultivation faces challenges like low adaptation, poor crop establishment, and low-yielding varieties. Specific planting geometries can address these issues and improve agricultural sustainability.

Study Objectives:

- **Evaluate different maize planting geometries for incorporation into Pakistan's traditional cropping systems.**
- **Assess soybean intercropping techniques on growth, yield, and soil fertility under Faisalabad's agro-ecological conditions.**

METHOD

The experiment was conducted during the autumn of 2019 at the Agronomic Research Area, University of Agriculture, Faisalabad, Pakistan, with sandy clay loam soil. Soil samples were collected from 0–30 cm depth to analyze physiochemical properties. Maize (Pioneer-DK8148) and soybean (Faisal variety) were sown using a seed rate of 25 kg ha^{-1} and 75 kg ha^{-1}, respectively. Fertilizers were applied at 125 kg P, 125 kg K, and 250 kg N per hectare, with nitrogen split across three stages (sowing, knee height, flowering). Seven irrigations were applied during the crop cycle, with thinning, weeding, and insecticide applications carried out as needed.

Experimental Design The factorial experiment was arranged in a randomized complete block design (RCBD) with three replications.

Factor A (Maize Planting Geometries):

P1: Alternate single rows on 75 cm apart ridges

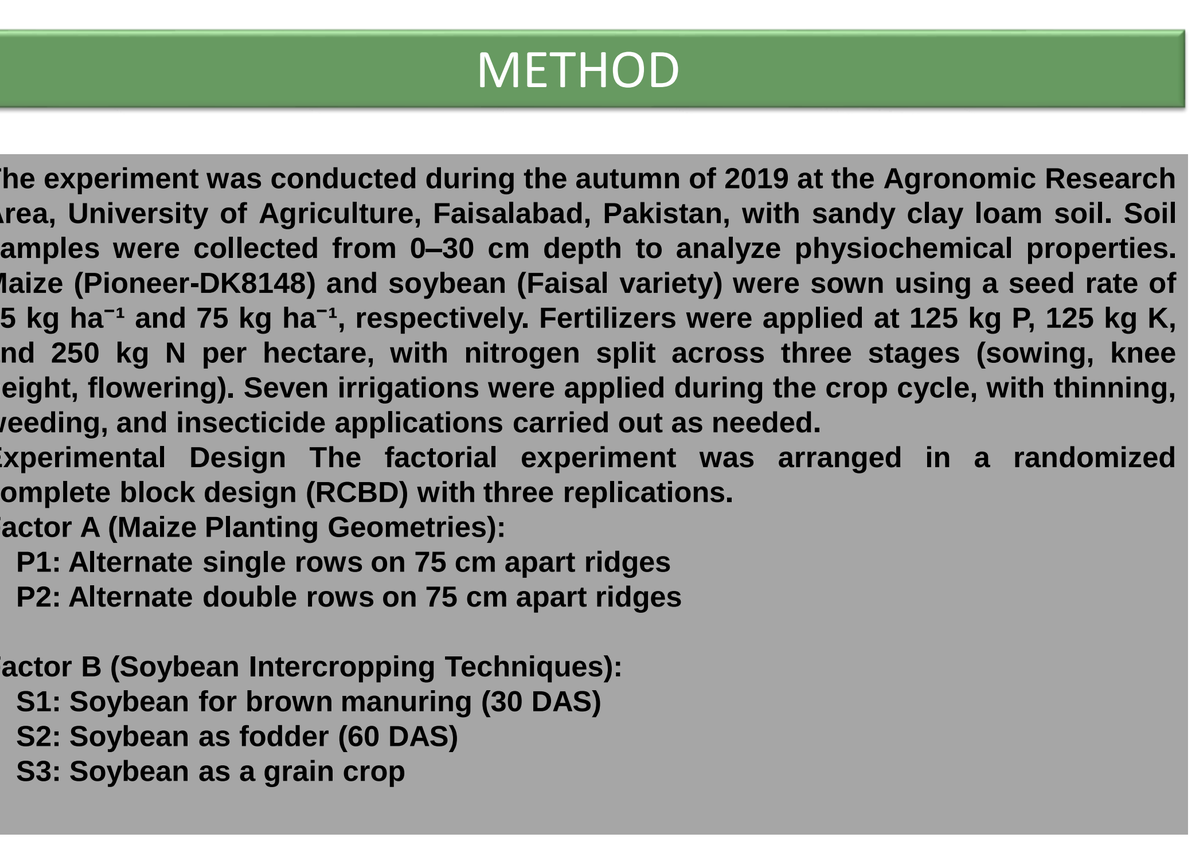
P2: Alternate double rows on 75 cm apart ridges

Factor B (Soybean Intercropping Techniques):

S1: Soybean for brown manuring (30 DAS)

S2: Soybean as fodder (60 DAS)

S3: Soybean as a grain crop



RESULTS & DISCUSSION

Maize Parameters:

Plant Height: Maximum height was observed at P1CK (217.33 cm), and minimum at P2S3 (172 cm). Intercropping induced competition, impacting plant height.

Cob Length: Maximum cob length was recorded at P1CK (22.24 cm), while minimum was at P2S3 (13.97 cm). Intercropping reduced cob length due to resource competition.

Cob Diameter: Significant differences were found, with the highest diameter at P1CK (4.63 cm) and lowest at P2S3 (3.63 cm).

Total Grains per Cob: The maximum grains per cob were at P1CK (496.13), while P2S3 had the least (373.06), affected by intercropping competition.

1000-Grain Weight: The highest weight was observed in P1CK (280.30 g) and the lowest in P2S3 (209.03 g), highlighting the role of planting geometries.

Biological Yield: Maximum yield was at P1CK (19.10 t/ha), while P2S3 had the lowest (11.29 t/ha), impacted by competition for resources.

Grain Yield: Grain yield was highest at P1CK (10.76 t/ha) and lowest at P2S3 (5.86 t/ha), showing reduced yield in intercropping systems.

Harvest Index: The highest index was recorded in P1CK (55.12%), with the lowest in P2S3 (43.39%).

Soybean Parameters:

Plant Height: Maximum height was recorded at P2S3 (95 cm), and minimum at P1S3 (87.33 cm), influenced by maize dominance.

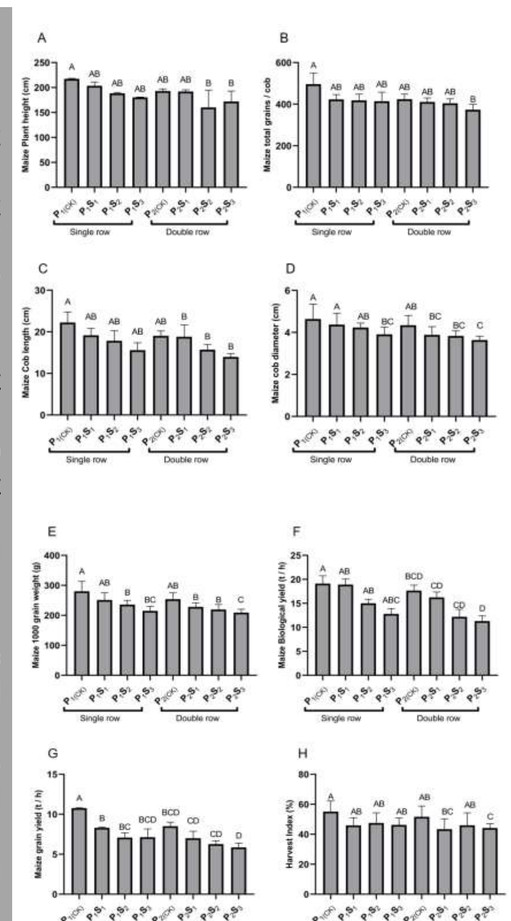
Number of Pods per Plant: The highest number of pods was at P1S3 (137.33), reflecting reduced competition in single-row maize planting.

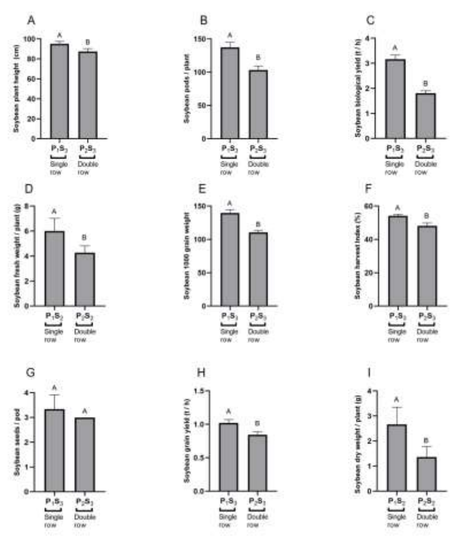
1000-Grain Weight: The highest weight was observed at P1S3 (139.66 g), while the lowest was at P2S3 (110.66 g), influenced by competition.

Biological Yield: Maximum yield was at P1S3 (3.16 t/ha), and the lowest at P2S3 (1.81 t/ha).

Grain Yield: The highest grain yield was recorded at P1S3 (1.02 t/ha), with the lowest at P2S3 (0.84 t/ha).

Harvest Index: Maximum harvest index was noted at P1S3 (54.17%), showing improved efficiency in single-row planting.





Treatments	Nutrients	Before	After
P_1S_1: Soybean for brown manuring	Nitrogen content %	0.05	0.09
	Available Phosphorous (ppm)	7.57	9.33
	Available Potassium (ppm)	173	205.33
	Organic matter contents (%)	0.85	1.09
P_2S_1: Soybean for brown manuring	Nitrogen content %	0.04	0.07
	Available Phosphorous (ppm)	7.62	9.13
	Available Potassium (ppm)	172	189.33
	Organic matter contents (%)	0.86	0.94

CONCLUSION

This study shows that intercropping maize with soybean is a practical and beneficial farming practice for Faisalabad, Pakistan. Although maize grain yield was slightly reduced, the economic benefits from soybean cultivation made up for the loss. Planting maize and soybean in alternate single rows on 75 cm ridges, with soybean grown as a grain crop, proved to be the most effective and profitable method. This approach improves soil fertility, optimizes resource use, and offers a sustainable solution for local farmers. Overall, maize-soybean intercropping has great potential to enhance agricultural productivity and economic returns while supporting sustainable farming practices.

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