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Effect of land configuration on growth and production efficiency of maize (*Zea mays* L.) under maize-wheat cropping system

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Abstract
A field experiment was conducted during *kharif* seasons of 2016-17 and 2017-18 at the College of Agriculture, RVSKVV, Indore, (M.P.) to assess the effect of land configuration on maize under maize-wheat system. Shoot growth of maize *viz*. plant height at harvest and dry weight/plant at 60 DAS was recorded significantly higher in minimum tillage with ridge and furrow sowing during 2016-17 and 2017-18. Leaf area index at 60 DAS of maize was obtained significantly superior in minimum tillage with ridge and furrow sowing in two years of study. Grain and stover yield and harvest index were observed significantly greater in minimum tillage with ridge and furrow sowing in both the years. Production efficiency was noted significantly higher in minimum tillage with ridge and furrow sowing followed by minimum tillage with broad bed furrow.

Keywords: Growth, maize, maize-wheat system, production efficiency, yield

Introduction
Maize is one of the most important cereal crops next to wheat and rice in terms of total production in the world. It is grown under diverse environmental condition and has varied uses as food, feed and fodder. In India maize accounts for an area of 11.03 million ha with a production of 28.64 m tonnes and a productivity of 25.68 q ha^{-1} (Anonymous, 2021) [1]. In Madhya Pradesh, about 67% area is under rainfed Agriculture which production is to greatly depends on water saving technologies. In general flatter *Vertisols* land of Malwa region is extensively used as flat-land cultivation system of *kharif* crops like maize, which faces the problem of water stagnation and poor aeration thereby affecting crop productivity adversely. The small changes through land configuration may help in improving the productivity of *Vertisols* of Malwa region. Maize-wheat and maize–chickpea are the most popular and profitable cropping systems, where factors like uncertainty of monsoon, higher temperature, degraded soils with low water holding capacity and nutrient deficiencies are contributing to low crop yields in rainfed/dry land areas. Maize is predominately grown during rainy season, and is an exhaustive crop and depletes the greater amount of available nutrients from soil and the moisture stress during intermittent crop growth period causes yield reduction and fluctuations in crop yield in these conditions. Therefore there is need a system which can protect the crop from water logging/ stagnation as well as prevent the crop from moisture stress condition by saving of water in the crop yield. Keeping these facts in view, the study was undertaken to study the efficiency of land configuration in *Vertisol* on maize under maize-wheat cropping systems in prevailing climatic conditions of Malwa region of Madhya Pradesh.

Materials and Methods
The field experiment was conducted during *kharif* and *rabi* seasons of 2016-17 and 2017-18 at the College of Agriculture, RVSKVV, Indore, (M.P.) The soil of the experimental field was medium black clay loam having pH of 7.5, organic carbon of 0.40%, EC of 0.23 dS/m, available N of 186.7 kg/ha, available P of 16.78 kg/ha, available K of 562 kg/ha,. The treatments comprised 4 four land configuration practices i.e. L_1: Conventional tillage with Flat bed sowing, L_2: Minimum tillage with Ridge and Furrow sowing, L_3: Conventional tillage with Broad bed furrow and L_4: Minimum tillage with Broad bed furrow in *kharif* and in *rabi*. L_1: Zero tillage (no till), L_2: Minimum tillage L_3: Minimum tillage with Broad bed furrow and L_4: Conventional tillage NPK to maize-wheat system.

These 4 land configuration practices were tested in randomized block design with 3 replications. Maize (KMH-25K45) were sown 7nd July, 2016 and 9th July 2017 and harvest on 12th and 14th October, 2016 and 2016 during two consecutive years. The maize crop was grown as per recommended package of practices. However, the observation was noted as per standard procedure. Leaf area index is the ratio of total upper leaf surface of vegetation divided by the surface area of the land on which the vegetation grows. LAI is used to predict photosynthetic primary production and as a reference tool for crop growth as suggested by Watson (1947) [8]. The production efficiency was calculated as per the formula adopted by Kumawat *et al.* (2012) [6].

$$\text{Production efficiency} = \frac{Grain\ yield\ (kg/ha)}{Total\ duration\ taken\ by\ crop\ (days)}$$

Data generated were subjected to analysis of variance (ANOVA) and Critical Difference (CD) at 5% probability level (Gomez and Gomez, 1984) [2].

Results and Discussion

Growth

Growth parameters of maize *viz*. plant height was recorded significantly higher in minimum tillage with ridge and furrow sowing (163.61 and 164.33 cm) followed by minimum tillage with broad bed furrow and conventional tillage with broad bed furrow sowing in two consecutive years at 60 DAS. However, land configuration practice (L_2) like minimum tillage with ridge and furrow sowing observed significantly maximum dry weight per plant (97.15 and 100.14 g) and Leaf area index (LAI) of 5.35 and 5.40 over rest of land configuration treatments during two consecutive years. This could be ascribed due to regulate the moisture stress in soil under different land configuration practices. The higher growth parameters under minimum tillage with ridge and furrow sowing as well as modified land configuration over conventional tillage with broad bed furrow sowing were also reported by Kumar *et al*. (2021) [5] and Kashif *et al.* (2006) [4].

Yield

Seed and straw yield of maize was recorded significantly L_2 maximum in minimum tillage with ridge and furrow sowing (44.43 and 45.07 q/ha) and (44.43 and 45.07 q/ha) over rest of the land configuration during both the years (Table 2). Grain yield was noted to the line of 18.0% and 23.25% more under minimum tillage with ridge and furrow sowing (L_2) over conventional tillage with flat bed sowing during two respective years. This could be ascribed due to greater shoot and root growth of maize which led to more yield attributes and resulted to superior grain and stover yield. This might be due to better harvesting of solar radiation and higher chlorophyll content which helped the plant to accumulate more photosynthates in leaves, stem and reproductive parts. The higher grain yield with ridges and furrow method and corrugated furrow method might be due to improved growth parameters led to better dry matter accumulation, nutrient uptake and yield attributes. This result was conformity with the findings of Halli and Angadi (2019) [3]. Similar results of higher yields in altered land configuration over conventional tillage with flat bed sowing were also reported by Yau *et al.* (2010) [9]. The higher yields in altered land configuration over conventional tillage with flat bed sowing were also reported Sharma and Gautam (2010) [7] and Kumar *et al*. (2021) [5].

Table 1: Growth parameter of maize as influenced by land configuration in maize-wheat cropping system

Treatments	Plant height (cm) at 60 DAS		Dry wt/plant (g) at 60 DAS		Leaf area index	
Land configuration	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
L_1- CT+FB	152.34	156.03	92.03	96.63	4.79	4.87
L_2- MT+RF	163.61	164.33	97.15	100.14	5.35	5.40
L_3- CT+BBF	157.00	158.10	93.88	97.46	4.86	4.99
L_4- MT+BBF	160.17	160.25	94.72	99.23	5.05	5.17
SE (m)	1.24	1.10	0.19	0.85	0.08	0.10
CD (P=0.05)	3.73	3.31	0.57	2.54	0.23	0.30

CT: Conventional tillage, FT: Flat bed, MT: Minimum tillage, RF: Ridge and furrow, BBF: Broad bed furrow

Table 2: Yield and production efficiency of maize crop as influenced by land configuration in maize-wheat cropping system

Treatments	Grain yield (q/ha)		Straw yield (q/ha)		Production efficiency	
Land configuration	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
L_1- CT+FB	37.64	38.41	74.33	74.51	33.06	33.82
L_2- MT+RF	44.43	45.07	76.22	76.33	37.11	37.13
L_3- CT+BBF	38.49	42.62	74.77	75.92	33.97	35.73
L_4- MT+BBF	43.93	44.17	75.14	76.13	36.72	36.80
SE (m)	0.17	0.65	0.14	0.14	0.60	0.70
CD (P=0.05)	0.50	1.94	0.41	0.41	1.80	2.08

CT: Conventional tillage, FT: Flat bed, MT: Minimum tillage, RF: Ridge and furrow, BBF: Broad bed furrow

Production efficiency

The production efficiency was reported higher under in minimum tillage with ridge and furrow sowing (L_2) (31.11 and 37.13 kg/ha/day) followed by minimum tillage with Broad bed furrow sowing (36.72 and 36.80 kg/ha/day) during 2016-17 and 2017-18, respectively. This might be due to superior grain yield of maize under aforesaid treatment as obtained in same duration of crop.

Conclusion

Thus, it can be concluded that application minimum tillage with ridge and furrow sowing (L_2) was found best treatment for higher growth, seed yield and production efficiency of maize crop.

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