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# Production and productivity of mustard (*Brassica juncea* L.) intercropped in kabuli chickpea (*Cicer kabulium* L.) using land configuration

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**Abstract**
The investigation entitled "effect of intercropping of mustard (*Brassica juncea* L.) With kabuli chickpea (*Cicer kabulium* L.) Using land configuration on productivity and profitability" a research project was done at the organic research farm, Karguanji, institute of agricultural sciences, Bundelkhand University, Jhansi (u.p.) during rabi season 2019-20 and 2020-21. The experiment was laid out in a randomized complete block design with three replications with sowing methods using land configurations. The result revealed that, different land configuration significantly influenced growth parameters *viz*., plant height, dry weight of plant, yield attributes and yield of mustard and chickpea. The sowing of mustard and kabuli chickpea under furrow system and broad bed was identified to better method of intercropping compared to sole cropping of both as the growth parameters were slightly reduced but ultimately the yield equivalent term was apparently higher. Mustard grown in furrows + kabuli chickpea broad beds in ratio 1:3 under broad bed and furrow system gave higher yield and mustard equivalent yield, kabuli chickpea equivalent yield, land equivalent ratio LER. Thus, the broad bed and furrow system was identified to be most suitable sowing method for obtaining higher yield from mustard and kabuli chickpea intercropping under organic farming in Bundelkhand region of Uttar Pradesh.

**Keywords:** Mustard, kabuli chickpea, intercropping, land configuration, growth, yield

## Introduction
Indian mustard occupied more than 70% of the land used for the rapeseed-mustard crop group in India with a yield of 1188 kg/ha and an area harvested of 6.7 million hectares, India produced 8.0 million tonnes of rapeseed mustard. (Anonymous 2015) [2]. The third-largest edible legume produced worldwide, behind field pea and common bean, is chickpea. (Gaur *et al*., 2010) [7]. The chickpea crop has the highest area (6.4 mha), Production (5.1 m tonnes), and productivity (796 kg/ha). (Anonymous 2018) [3]. Increases in chickpea or mustard production are a key determinant of the system's profitability and sustainability since the system's low productivity is a critical problem. The limited research on nutrient-integrated chickpea/mustard intercropping indicate that the productivity of these crops will be increased and will remain high over time. (Kushwaha and De, 1987) [11]. In the vast rainfed plains of the nation, intercropping is one of the finest agronomical solutions to reduce risk and will serve as insurance against main crop failure. Because there is a lack of knowledge regarding the effects of integrated nutrient application in the chickpea-mustard intercropping system, the current study was conducted to determine whether using a combination of organic, inorganic, and biofertilizers under moisture-stress conditions could increase sustainable yield.
In order to reduce soil erosion and increase the effectiveness of field crops' use of water, land management systems are crucial. Easy and uniform germination as well as growth and development of plant are provided by manipulation of sowing method. Land configuration increases water use efficiency as reported by (Deshmukh *et al.*, 2014) [25]. Land configuration method includes the alteration of shape of seed bed and land surface. The growers of rapeseed, mustard, and other crops use a variety of sowing techniques to increase yields compared to flat

beds or conventional sowing techniques. These techniques include broad bed and furrow sowing, furrow sowing, tied ridge sowing, ridge with mulches, alternate furrow sowing, and ridge sowing. Furrow planting offers better conditions for plant growth because it increases soil moisture, increases salt leaching, and decreases soil surface evaporation. (Zhang *et. al.*, 2011; Singh *et al.* 2017) [24, 19]. Modified land configurations, such as furrow irrigated raised bed (FIRB) has shown good promise in enhancing chickpea performance (Jat *et. al.* 2005; Ahlawat *et. al.*, 2005) [8, 1]. The limited studies are available on mustard + kabuli chickpea intercropping systems particularly under organic management.

## Materials and Methods

A field experiment was carried out Organic Research Farm, Karguanji, Institute of Agricultural Sciences, Bundelkhand University, Jhansi (U.P.). to study "effect of intercropping of Mustard (*Brassica juncea* L.) with Kabuli Chickpea (*Cicer kabulium* L.) using land configuration on productivity and profitability'' during *Rabi* season of 2020-2021. The Jhansi district of Uttar Pradesh has a subtropical climate. Throughout the growth season, 123.8 mm of rainfall overall. 5.2 °C to 15.1 °C and 21.0 °C to 35.1 °C, respectively, were the weekly maximum and lowest temperatures for the course of the trial. The experimental plot's soil type was sandy clay loam with a low organic carbon content of 0.45%, low levels of accessible potassium (235 kg/ha), nitrogen (164 kg ha-1), and phosphorus (28.5 kg/ha), but high levels of the latter two. With an electrical conductivity of 0.26 dS/m, the soil reaction in the experimental field was almost neutral (pH 7.2).

The experiment was laid out in a randomized block design, with two crops i.e. Mustard (cv. NRCHB101) and Chickpea (Pusa 1053) and 10 land configuration [$T_1$: Mustard alone (FB) - (control I), $T_2$: Kabuli Chickpea alone (FB) - (control II), $T_3$: Mustard (FB) +Kabuli Chickpea (FB)(1:1), $T_4$: Mustard (FB) + Kabuli Chickpea(FB)(2:2), $T_5$: Mustard (FB) + Kabuli chickpea (FB)(2:1), $T_6$: Mustard (LB) +Kabuli Chickpea (UB)(2:2) PR, $T_7$: Mustard (SLB) + Kabuli Chickpea (R)(2:1) SLBR, $T_8$: Mustard (F) +Kabuli Chickpea (BB)(1:3) BBF, $T_9$: Mustard (F) +Kabuli Chickpea (NB)(1:2) NBF, $T_{10}$: Mustard (F) + Kabuli Chickpea (R) (1:1) FIRB]. 10 rows, 38 meter long) 3.4 m x 3.4 m. *Rhizobium* culture were used to trat the seeds of chickpea and sown in well-prepared land by dibbling method with seed rates of 4 and 80 kg $ha^{-1}$ for mustard and chickpea respectively A spacing of 45 × 10 cm for mustard and 30 × 10 cm for Kabuli Chickpea was adopted. Nitrogen, phosphorus and potassium (RBF) were applied in the ratio of 20:40:20 kg $ha^{-1}$ as basal dose through the mixture of FYM, Vermicompost and Poultry manure 1/3 each. The crop was grown under rainfed condition with one pre-sowing irrigation was applied to the crop 7 days before sowing and only one lifesaving irrigation was applied. Weeding was done with the help of dryland weeder between the crop rows at 30 days and 45 days after sowing. Crops was Harvested manually with sickle and tied in bundles with tags from each plot and left for sun drying. Threshing operations were also performed treatment wise manually. The growth parameters, *viz.* plant height (cm), fresh weight/plant (g/plant), dry matter/plant (g/plant) and CGR at the 30, 60 and 90 DAS of both mustard and chickpea. Various yield parameter, *viz*. seed yield (kg/ha), Stover yield (kg/ha) and harvest index and equivalent yield at the time of harvesting of mustard and chickpea. The data on various parameters were statistically analysed by using CPCS-1 (Cochran and Cox, 1967) [6].

## Results and Discussion

### Growth parameters of Mustard

### Plant height (cm)

The plant height was significantly influenced by all treatment combinations at 30, 60 and 90 DAS (Table 1). A perusal of the data showed that maximum plant height was recorded in $T_1$ mustard alone (FB), at 30, 60 and 90 days after sowing which was at par with $T_7$ mustard (SLB) + kabuli chickpea (R) (2:1) (SLBR) but significantly better than rest of the treatments in 2020. However, at 90 DAS, treatment $T_4$ and $T_6$ were also at par with $T_1$ whereas treatment $T_4$ was at par with $T_1$. This might be due to better light interception and better moisture availability in shallow beds. The results are in conformity with those already reported by Singh *et al.* (2010) [18] and Yadav *et al.* (2010) [23].

### Fresh weight of plant (g)

There was a gradual increase in fresh weight of plant with advancement in all the treatment combinations (Table 1). Significant differences with respect to fresh weight of plant of mustard were found at all the dates of observations. Maximum fresh weight of plant found in $T_1$- mustard alone (FB), which was at par with $T_7$- mustard (SLB) + kabuli chickpea (R) (2:1) (SLBR) but significantly higher than rest of the treatments. The same findings also reported by Yadav *et al.* (2010) [23].

**Table 1:** The Plant Height and Fresh Weight Plant of mustard as influenced by sowing methods using land configurations for intercropping of Mustard with Kabuli Chickpea in organic management during 2019 and 2020

| Treatments | Plant height (cm) | | | Fresh weight plant (g) | | |
|---|---|---|---|---|---|---|
| | 30 DAS | 60 DAS | 90 DAS | 30 DAS | 60 DAS | 90 DAS |
| $T_1$- Mustard alone (FB) | 17.53 | 123.70 | 205.34 | 15.60 | 81.55 | 479.46 |
| $T_2$- Kabuli Chickpea (FB) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| $T_3$- M (FB) + KC (FB) (1:1) | 16.48 | 112.55 | 188.12 | 14.43 | 72.18 | 445.85 |
| $T_4$- M (FB) + KC (FB) (2:2) (PR) | 16.92 | 118.92 | 197.44 | 15.05 | 77.63 | 464.27 |
| $T_5$- M (FB) + KC (FB) (2:1) (PR) | 16.05 | 109.46 | 185.67 | 14.12 | 70.58 | 437.14 |
| $T_6$- M (LB) + KC (UB) (2:2) (PR) | 16.76 | 115.34 | 191.73 | 14.67 | 74.70 | 456.58 |
| $T_7$- M (SLB) + KC (R) (2:1) SLBR | 17.24 | 121.40 | 202.56 | 15.38 | 79.25 | 472.63 |
| $T_8$- M (F) +KC (BB) (1:3) BBF | 13.37 | 101.25 | 170.81 | 12.56 | 61.74 | 398.35 |
| $T_9$- M (F) +KC (NB) (1:2) NBF | 14.90 | 106.18 | 178.25 | 13.31 | 66.48 | 416.07 |
| $T_{10}$- M (F) + KC (R) (1:1) FIRB | 15.54 | 107.84 | 181.96 | 13.74 | 68.32 | 429.44 |
| SEm± | 0.25 | 1.37 | 3.70 | 0.19 | 0.94 | 5.26 |
| CD at 5% | 0.75 | 4.12 | 11.09 | 0.56 | 2.80 | 15.75 |

**Note:** M- Mustard, KC- Kabuli chickpea, FB- Flat beds system, PR- Paired row system SLBR- Shallow lower bed & Ridge system, BBF- Broad bed & Furrow, NBF- Narrow bed and Furrow system and FIRB- Furrow irrigated raised bed

**Dry matter of plant (g):** Dry matter of plant significantly increased in the all the treatments combination at 30, 60 and 90 DAS (Table 2). The maximum dry matter of plant recorded with value $T_1$ mustard alone (FB), which was at par with $T_7$- mustard (SLB) + kabuli chickpea (R) (2:1) (SLBR) but significantly better than rest of the treatments. However, at 90 DAS treatment $T_4$ and $T_6$ were also at par with $T_1$ respectively. Increase in dry matter might be due to better availability of space for efficient utilization of light, water and nutrients available to the individual plants, resulting in higher photosynthetic activity which increased leaf area and consequently result in higher dry matter production. The results are in conformity with those already reported by Punia *et al.* (1999) [14], Khafi *et al.* (1997) [10], and Yadav *et al.* (2010) [23].

**Yield of Mustard**

**Seed yield (q ha$^{-1}$)**

It is evident from the data that all the treatments exerted significant variation on seed yield (Table 2). The maximum seed yield (30.18 q ha$^{-1}$ was obtained with $T_1$ mustard grown alone on (FB). The second-best treatment was found $T_7$ mustard (SLB) + kabuli chickpea (R) (2:1) (SLBR) representing, yield of 28.14 q ha$^{-1}$. The percent reduction in mustard yield due to intercropping was maximum in treatment $T_8$ (43.63%) while it was minimum yield reduction was found in treatment $T_7$ (6.75%) when compared with sole cropping. Similar results also reported by Bultar *et al.* (2010) [5], Singh *et al.* (2010) [18] and Lakshman *et al.* (2010) [12]. Who reported positive correlation between grain yield plant$^{-1}$ with number of branches, leaves, leaf area, straw yield plant$^{-1}$ and 1000 seed weight.

**Table 2:** The Dry Weight and Yield of mustard plant as influenced by sowing methods using land configurations for intercropping of Mustard with Kabuli Chickpea in organic management during 2019 and 2020

| Treatments | Dry matter of plant (g): | | | | | | Yield | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | | | 2020 | | | 2019 | | | 2020 | | |
| | 30 DAS | 60 DAS | 90 DAS | 30 DAS | 60 DAS | 90 DAS | Grain yield (q ha$^{-1}$) | Straw yield (q ha$^{-1}$) | Reduction in mustard yield (%) | Grain yield (q ha$^{-1}$) | Straw yield (q ha$^{-1}$) | Reduction in mustard yield (%) |
| $T_1$- Mustard alone (FB) | 2.28 | 9.50 | 68.13 | 2.45 | 10.30 | 66.74 | 31.92 | 39.56 | - | 30.18 | 37.27 | - |
| $T_2$- Kabuli Chickpea (FB) | - | - | - | 0.00 | 0.00 | 0.00 | - | - | - | - | - | - |
| $T_3$- M (FB) + KC (FB) (1:1) | 2.09 | 9.16 | 62.35 | 1.83 | 9.14 | 59.08 | 24.10 | 34.90 | 24.46 | 22.80 | 32.70 | 24.45 |
| $T_4$- M (FB) + KC (FB) (2:2) (PR) | 2.19 | 9.32 | 68.20 | 2.17 | 9.68 | 65.12 | 23.40 | 34.52 | 26.69 | 21.95 | 33.02 | 27.26 |
| $T_5$- M (FB) + KC (FB) (2:1) (PR) | 2.04 | 9.08 | 60.05 | 1.73 | 8.82 | 57.50 | 20.53 | 34.56 | 35.68 | 18.83 | 32.96 | 37.60 |
| $T_6$- M (LB) + KC (UB) (2:2) (PR) | 2.15 | 9.12 | 67.04 | 1.95 | 9.47 | 64.64 | 25.36 | 34.44 | 20.55 | 23.76 | 32.49 | 21.27 |
| $T_7$- M (SLB) + KC (R) (2:1) SLBR | 2.24 | 9.45 | 68.48 | 2.41 | 10.01 | 66.26 | 29.94 | 38.80 | 6.14 | 28.14 | 36.96 | 6.75 |
| $T_8$- M (F) +KC (BB) (1:3) BBF | 1.76 | 7.58 | 51.33 | 1.35 | 7.62 | 50.73 | 18.61 | 34.19 | 41.07 | 17.01 | 32.99 | 43.63 |
| $T_9$- M (F) +KC (NB) (1:2) NBF | 1.83 | 8.87 | 55.21 | 1.52 | 8.35 | 55.27 | 21.96 | 34.83 | 31.20 | 20.27 | 32.23 | 32.83 |
| $T_{10}$- M (F) + KC (R) (1:1) FIRB | 1.98 | 9.95 | 57.83 | 1.67 | 8.51 | 56.35 | 23.06 | 34.96 | 27.75 | 21.26 | 32.85 | 29.55 |
| SEm± | 0.03 | 0.12 | 1.06 | 0.03 | 0.11 | 1.02 | 0.223 | 0.48 | - | 0.201 | 0.44 | - |
| CD at 5% | 0.09 | 0.37 | 3.18 | 0.08 | 0.32 | 3.11 | 0.69 | 1.43 | - | 0.62 | 1.38 | - |

**Note**: M- Mustard, KC- Kabuli chickpea, FB- Flat beds system, PR- Paired row system, SLBR- Shallow lower bed & Ridge system, BBF- Broad bed & Furrow, NBF- Narrow bed and Furrow system and FIRB- Furrow irrigated raised bed

**Stover yield (q ha$^{-1}$)**

An examination of data shows that stover yield (ha$^{-1}$) of mustard significantly increased the maximum stover yield was found in $T_1$ mustard alone (FB) (37.27 q ha$^{-1}$ during 2020). The second best treatment was $T_7$ mustard (SLB) + kabuli chickpea (R) (2:1) (SLBR) representing, (36.96 q ha$^{-1}$). The same findings also reported by Singh *et al.* (1998) [20].

**Growth parameters of Chickpea**

**Plant height (cm)**

The significantly higher plant height was found in $T_2$ Kabuli chickpea alone (FB), which was at par with $T_8$ mustard (F) + kabuli chickpea (BB) (1:3) (BBF), and $T_6$ mustard (LB) + kabuli chickpea (UB) (2:2) (PR) but significantly better than rest of the treatments during (Table 3). However, at 90 DAS $T_2$ was at par with $T_8$ mustard (F) + kabuli chickpea (BB) (1:3) (BBF), but significantly better than rest of the treatments. It was mainly due to the fact that due to increased soil moisture, increased plant growth which influence plant height The similar findings also reported by Sher *et al.* (2006) [17].

**Fresh weight of plant (g)**

The significantly higher fresh weight of plant (g) were recorded with in $T_2$- Kabuli chickpea alone (FB), which was at par with $T_8$ mustard (F) + kabuli chickpea (BB) (1:3) (BBF), and $T_6$ at 30 DAS but significantly better than rest of the treatments. At 60 DAS, $T_2$ was significantly better than rest of the treatments (Table 3). However, at 90 DAS, $T_8$ and $T_6$ was also at par with $T_2$. The similar trends were also reported by Javiya *et al.* (1989) [9], Singh *et al.* (2010) [18] and Thenua *et al.* (2010) [21].

**Table 3:** The plant height and Fresh weight plant of chickpea as influenced by sowing methods using land configurations for intercropping of Mustard with Kabuli Chickpea in organic management during 2019 and 2020

| Treatments | Plant height (cm) | | | | | | Fresh weight plant (g) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | | | 2020 | | | 2019 | | | 2020 | | |
| | 30 DAS | 60 DAS | 90 DAS | 30 DAS | 60 DAS | 90 DAS | 30 DAS | 60 DAS | 90 DAS | 30 DAS | 60 DAS | 90 DAS |
| $T_1$- Mustard alone (FB) | - | - | - | - | - | - | - | - | - | - | - | - |
| $T_2$- Kabuli Chickpea (FB) | 13.22 | 32.90 | 48.78 | 13.15 | 32.27 | 47.32 | 16.67 | 45.96 | 85.37 | 15.70 | 44.63 | 82.35 |
| $T_3$- M (FB) + KC (FB) (1:1) | 11.85 | 26.49 | 41.25 | 11.83 | 27.78 | 41.27 | 12.56 | 31.11 | 71.25 | 11.82 | 30.15 | 69.53 |
| $T_4$- M (FB) + KC (FB) (2:2) (PR) | 12.50 | 29.18 | 43.56 | 12.06 | 30.55 | 44.54 | 14.02 | 33.63 | 75.28 | 14.05 | 34.39 | 74.27 |
| $T_5$- M (FB) + KC (FB) (2:1) (PR) | 12.65 | 30.32 | 43.82 | 12.32 | 30.80 | 44.89 | 14.31 | 34.27 | 77.33 | 14.38 | 35.74 | 75.39 |
| $T_6$- M (LB) + KC (UB) (2:2) (PR) | 13.08 | 32.25 | 46.08 | 12.71 | 31.64 | 45.75 | 16.00 | 40.65 | 82.60 | 15.22 | 41.52 | 80.25 |
| $T_7$- M (SLB) + KC (R) (2:1) SLBR | 12.65 | 31.46 | 44.42 | 12.44 | 31.15 | 45.26 | 14.76 | 35.19 | 78.20 | 14.76 | 37.91 | 77.81 |
| $T_8$- M (F) +KC (BB) (1:3) BBF | 13.16 | 32.64 | 47.15 | 12.97 | 31.85 | 46.12 | 16.28 | 42.04 | 83.91 | 15.49 | 42.37 | 81.94 |
| $T_9$- M (F) +KC (NB) (1:2) NBF | 12.98 | 31.92 | 45.36 | 12.63 | 31.38 | 45.30 | 15.43 | 37.31 | 81.72 | 14.53 | 39.70 | 78.55 |
| $T_{10}$- M (F) + KC (R) (1:1) FIRB | 12.32 | 31.04 | 44.73 | 12.13 | 30.50 | 43.85 | 15.17 | 36.49 | 79.86 | 13.64 | 33.24 | 73.48 |
| SEm± | 0.18 | 0.40 | 0.39 | 0.18 | 0.39 | 0.38 | 0.23 | 0.43 | 1.13 | 0.22 | 0.42 | 1.14 |
| CD at 5% | 0.55 | 1.20 | 1.38 | 0.50 | 1.15 | 1.37 | 0.68 | 1.30 | 3.37 | 0.63 | 1.27 | 3.31 |

**Note:** M- Mustard, KC- Kabuli chickpea, FB- Flat beds system, PR- Paired row system, SLBR- Shallow lower bed & Ridge system, BBF- Broad bed & Furrow, NBF- Narrow bed and Furrow system and FIRB- Furrow irrigated raised bed

**Dry weight of plant (g)**

It is obvious from data that the significantly higher dry shoot weights of plant (g) were recorded with in $T_2$ Kabuli chickpea alone (FB), which was at par with $T_8$ mustard (F) + kabuli chickpea (BB) (1:3) (BBF), and $T_6$ but significantly better than rest of the treatments throughout the research experiment (Table 4). The same findings also reported by Singh *et al.* (2010) [18] and Thenua *et al.* (2010) [21].

**Yield of Chickpea**

**Grain yield (q ha$^{-1}$)**

The significantly higher grain yield (22.89 q ha$^{-1}$) was recorded $T_2$ Kabuli chickpea grown alone on (FB). The second-best treatment was $T_8$ mustard (FB) + kabuli chickpea (BB) (1:3) when (BBF), given the yield of (16.90 q ha$^{-1}$). The reduction in grain yield of chickpea (26.17%) is due to intercropping of mustard in treatment $T_8$ which it was maximum (68.33%) in $T_7$ during 2020 (Table 4). When compared with conventional sole cropping. Similar findings recorded by Saraf *et al.* (2010) [16], Bahadur *et al.* (2002) [4].

**Straw Yield (q ha$^{-1}$)**

All the treatments showed a significant increase in straw yield q ha$^{-1}$. The maximum straw yield (29.67 and 25.50 q ha$^{-1}$ during 2019 and 2020 respectively) was recorded with $T_2$ Kabuli chickpea grown alone (FB). The second-best treatment was found $T_8$ mustard (F) + kabuli chickpea (BB) (1:3) (BBF), representing 19.20 q ha$^{-1}$ straw yield (Table 4). Similar findings also reported by Saini and Faroda (1998) [15] and Bahadur *et al.* (2002) [4].

**Table 4:** The Dry weight and Yield of chickpea as influenced by sowing methods using land configurations for intercropping of Mustard with Kabuli Chickpea in organic management during 2019 and 2020

| Treatments | Dry matter of plant (g): | | | | | | Yield | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2019 | | | 2020 | | | 2019 | | | 2020 | | |
| | 30 DAS | 60 DAS | 90 DAS | 30 DAS | 60 DAS | 90 DAS | Grain yield (q ha$^{-1}$) | Straw yield (q ha$^{-1}$) | Reduction in mustard yield (%) | Grain yield (q ha$^{-1}$) | Straw yield (q ha$^{-1}$) | Reduction in mustard yield (%) |
| $T_1$- Mustard alone (FB) | - | - | - | 0.00 | 0.00 | 0.00 | - | - | - | 0.00 | 0.00 | - |
| $T_2$- Kabuli Chickpea (FB) | 3.34 | 11.88 | 21.25 | 3.26 | 10.75 | 21.48 | 23.28 | 29.67 | - | 22.89 | 25.50 | - |
| $T_3$- M (FB) + KC (FB) (1:1) | 2.88 | 9.69 | 18.51 | 1.92 | 9.12 | 18.33 | 8.25 | 12.73 | 64.60 | 9.38 | 13.67 | 59.02 |
| $T_4$- M (FB) + KC (FB) (2:2) (PR) | 2.94 | 10.45 | 19.09 | 2.56 | 9.54 | 19.47 | 9.66 | 13.32 | 58.50 | 10.46 | 14.50 | 54.30 |
| $T_5$- M (FB) + KC (FB) (2:1) (PR) | 2.97 | 10.64 | 19.39 | 2.74 | 9.72 | 19.72 | 6.81 | 9.56 | 70.70 | 7.11 | 8.84 | 68.94 |
| $T_6$- M (LB) + KC (UB) (2:2) (PR) | 3.22 | 11.55 | 20.49 | 3.15 | 10.29 | 20.69 | 11.25 | 14.85 | 51.70 | 11.16 | 13.40 | 51.25 |
| $T_7$- M (SLB) + KC (R) (2:1) SLBR | 3.02 | 10.87 | 19.98 | 2.81 | 9.85 | 20.06 | 7.03 | 9.75 | 69.80 | 7.25 | 8.95 | 68.33 |
| $T_8$- M (F) +KC (BB) (1:3) BBF | 3.27 | 11.68 | 20.62 | 3.24 | 10.57 | 20.89 | 17.28 | 22.25 | 25.80 | 16.90 | 19.20 | 26.17 |
| $T_9$- M (F) +KC (NB) (1:2) NBF | 3.15 | 11.28 | 20.33 | 3.08 | 10.04 | 20.35 | 14.74 | 20.47 | 36.70 | 13.26 | 17.91 | 35.52 |
| $T_{10}$- M (F) + KC (R) (1:1) FIRB | 3.11 | 10.05 | 20.05 | 2.33 | 9.46 | 19.29 | 10.83 | 15.52 | 53.50 | 10.23 | 13.12 | 55.31 |
| SEm± | 0.04 | 0.15 | 0.26 | 0.04 | 0.13 | 0.28 | 0.15 | 0.29 | - | 0.13 | 0.27 | - |
| CD at 5% | 0.13 | 0.47 | 0.78 | 0.13 | 0.51 | 0.80 | 0.45 | 0.88 | - | 0.46 | 0.87 | - |

**Conclusion**

The findings of this study indicate that mustard with chickpea successfully can be grown under organic management using land configurations. The sowing of mustard in furrow and 3 rows of kabuli chickpea on broad beds in furrow irrigated broad bed system (BBF) system was identified to better method of

intercropping compared to sole cropping of both mustard and chickpea. The growth parameters of both mustard and chickpea were slightly reduced but ultimately the yield in equivalent term was apparently higher. The broad bed and furrow system was identified to be most suitable sowing method for obtaining higher yield from mustard and kabuli chickpea intercropping under organic farming in Bundelkhand region of Uttar Pradesh.

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