

Original Research Article

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Differential Levels of Fertilizer and Row Spacing Affects Growth and Yield of Brown Top Millet [*Brachiaria ramosa* (L.)] in Entisols of Bastar Plateau Zone of Chhattisgarh

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ABSTRACT

A field study was conducted at S.G. College of Agriculture and Research Station, Jagdarpur (Chhattisgarh). The experiment was laid out in a split plot design with 3 levels of fertilizer as main plot and 4 levels of row spacing as sub plot with 3 replications. Results showed that the highest values of fingers plant⁻¹ (9.9), finger length (16.3 cm), leaves plant⁻¹ (11.5), leaf length (18.1 cm), leaf area index (1.36), grains finger⁻¹ (519), biological yield (53.3 q ha⁻¹), grain yield (6.4 q ha⁻¹) and straw yield (46.9 q ha⁻¹) were recorded under 125% of RDF. These parameters increased significantly with the increase in level of fertilizer from 75 to 100 and 100 to 125% of RDF. The plant height and harvest index were recorded significantly higher under 125% of RDF than 100% RDF but 100 and 75% of RDF was at par with each other. The tillers plant⁻¹ and leaf width under 125% of RDF were significantly higher than 75% of RDF but at par with 100% RDF. The test weight under 125% of RDF was at par with 100% RDF and significantly higher than 75% RDF. The highest values of plant height (106.9cm), leaf area index (1.49), biological yield (68.3 q ha⁻¹), grain yield (7.4 q ha⁻¹) and straw yield (60.9 q ha⁻¹) were recorded under 22.5 cm row spacing and these parameters increased significantly with narrowing the row spacing from 60 to 45, 45 to 30 and 30 to 22.5cm except plant height where 60 and 45cm spacing were at par. The highest values of tillers plant⁻¹ (6.0), secondary tillers plant⁻¹ (7.0), fingers plant⁻¹ (11.2), finger length (15.9 cm), leaves plant⁻¹ (11.4), leaf width (2.2 cm), leaf length (17.5 cm) and grains finger⁻¹ (485) were recorded under 60 cm of row spacing and these parameters decreased significantly with narrowing the row spacing from 60 to 45, 45 to 30 and 30 to 22.5cm except secondary tillers where 22.5 and 30cm was at par, leaves plant⁻¹ where 30 and 45 cm was at par and leaf width where 22.5 and 30cm and 45 and 60cm were at par. The leaf area index responded significantly to higher doses of fertilizer i.e. 100 and 125% of RDF at each level of row spacing. The leaf area index didn't respond to lower level of fertilizer i.e. 75% of RDF under wider row spacing i.e. 60 cm. Narrowing the row spacing from 45 to 30 or 22.5 cm, responded significantly to each and all the levels of fertilizer under study.

Keywords

Brown top millet,
Row spacing,
Fertilizer doses,
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Introduction

Every day, we make choices about the food we eat and our lifestyles. We can make choices for ourselves and our families that make a real difference to our ability to remain healthy and active now and enjoy life to its fullest in the future. Over past few years, the people are becoming conscious about the food habits and there is a lot of demand for nutritive food and people are switching to millets which are rich in nutrients. Millets are cereals with highly variable small-seeded grasses, which can be cultivated in the dry or degraded soils. The nutritive value is rich in millets that own 378.1 calories of energy, 11 g of protein, 8 mg of calcium, 195 mg of potassium, 3 mg of iron and 4.3g of fat per 100g (USDA, National Nutrient Database, 2015). These millets are serving to overcome malnutrition among rural poor, and one among such millet is this Brown top millet. It can be a source to overcome malnutrition.

Browntop millet (*Brachiaria ramosa* L.) belongs to the family Poaceae (Grass family) and is called with different names at different places like locally called as pedda-sama and korne, Korale in Kannada and Andakorra in Telugu (Fuller, 2014). It can be considered as both annual and perennial warm-season grass (Sheahan, 2014). It's an introduced annual grass originated from South East Asia. It's cultivated in Arabia, China, Australia and India (Clayton, 2006). Recently this crop is gaining popularity in several dry parts of India in terms of cultivation and consumption. It's a major staple crop of Deccan (Fuller *et al.*, 2004). In India, though the crop gaining lots of importance because of its nutritional value; its cultivation and the distribution is very low and is restricted to Andhra Pradesh, Karnataka, and Tamil Nadu states of South India (Kimata *et al.*, 2000). The brown top millets are also rich in many nutrients and are very delicious. The millet is free from gluten

and rich in essential nutrients. Also, it's rich in fiber (12.5%) compared to other crops. Lower incidence of cardiovascular diseases, duodenal ulcer, and hyperglycemia (diabetes), reported among those who regularly consume millets.

Nutrient supply in soil is one of the most important factors that determine the growth of the crop. Fertilizer is the major source of plant nutrients required in sufficient quantity to maintain the nutrient supply in the soil. The response of crop to fertilizers varies widely from place to place, depending upon the native fertility level of soil, environmental condition and genotype. A crop would express its full potential only when it is backed up by good agronomic practices. Optimum plant density provides conditions for proper light interception throughout the crop growth period. Further, it is important to realize that plant density should be defined not only in terms of number of plants per unit area but also in terms of arrangement of these plants on the ground (planting geometry/spatial arrangement) as it helps in efficient harvesting of solar energy with least competition for growth factors viz., water and nutrient uptake which ultimately decides the expression of phenotypic and genotypic character of the crop.

Chhattisgarh has four different soil types i.e. *Entisols*, *Inceptisols*, *Alfisols*, and *Vertisols* mainly developed by the action and interaction of relief, parent material, and climatic factors. *Entisols* cover 19.5% cultivated area of the state, most of the Bastar plateau contains these soils are known for absence or near absence of horizons that reflects the soil formation process. Though, the *Entisols* aren't thought well for the production of many crops, millets can be grown successfully. The soil is very hard and harsh which leads to limited root and shoot growth. With proper water supply and

fertilization, these soils can be used in agriculture (USDA-NRCS, 2006). Many attempts have been made to utilize the land for the millets still the information on agronomic practices, nutrient doses and their management are lacking.

Browntop millet, suitable for cultivation in *Entisols*, is very rich in nutrient value and can be utilized for eradication of malnutrition in the near future. Henceforth, an attempt has been made to undertake this study with the objective to calibrate optimum level of fertilizer with optimum plant population for yield maximization of brown top millet.

Materials and Methods

Location and physiographic setting

The experiment was carried out during Kharif 2019 at Upland Research cum Instructional Farm, Shaheed Gundadhur College of Agriculture and Research Station, Lamker, Jagdalpur, Bastar (Chhattisgarh).

Bastar plateau agro-climatic zone lies between the latitude ranging from 17044' to 20030' North and longitude from 82015' to 82020' East and, physiographically, is a part of Dandyakaranya upland, which is characterized by undulating topography with well marked elevations and depression with complex and heterogeneous setting (S. R. Ratre, 2014).

Climate and weather conditions

The climate of the zone is hot and sub humid with hot summer and cool winter. The zone receives an annual rainfall of 1300 to 1600 mm mostly in the month of July and August. The zone is flats in some parts while most of it undulating with slopes of varying magnitude (S. R. Ratre, 2014).

Soil type

In Bastar, the land is undulating and hence the soils vary considerably from top of the hillock to the valley. The soil types in Bastar district vary from *Marhan* (*Entisols*) to *Gabhar* (*Vertisols*). *Gabhar* is the valley portion of the undulating terrain. *Tikra* (*Inceptisols*) and *Mal* (*Alfisols*) lies in between these two (S. R. Ratre, 2014). Most of the Bastar plateau contains these *Entisols*. Though, the *Entisols* aren't good for the production of many crops, millets were grown better. It may form in a variety of climatic conditions. The soil is very hard and harsh which leads to limited root and shoot growth. With proper water supply and fertilization, these soils can be used in agriculture (USDA-NRCS, 2006).

Cropping history of the experimental field

Sometimes, the experimental results may get affected by the previous crop grown and the experiment carried out over there in that particular area. Henceforth, knowing the cropping history may help in solving many technical errors. The crops being taken during last 3 years were maize during kharif season of 2016 and 2017 and brown top millet during kharif season of 2018.

Experimental details

The field experiment was framed with a total of 12 treatment combination of the application of 3 differential levels of fertilizer with 4 differential levels of row spacing of brown top millet (variety wild) in a split plot design with 3 replications and its impact on crop yield was assessed after harvesting of crop. The fertilizer levels were composed of 75, 100 and 125% of recommended dose of fertilizer (RDF) which was 40:20:00 kg nitrogen: phosphorous: potassium ha⁻¹. The row spacing of brown top millet tested under study was 22.5, 30, 45 and 60 cm. In the

present experiment two split doses of nitrogen was applied, initial dose of 50% was applied during the time of sowing and the rest was applied 15 days after sowing.

Crop management

The plot was ploughed well using tractor drawn disc plough; cultivator was used to break the clods and to loosen the soil before taking the experiment. The layouts were made concerning different treatments and replications. The seeds which were locally available were hand sown in the experimental plot on 27 July 2019. Weeds may be the major obstacles in the present experiment. Henceforth, three hand weeding was carried out to suppress their activity. The plant protection measures were taken as per the need of the crop. Once when the fingers were matured the crop was harvested manually.

Observations recorded

Initial soil analysis

Initial soil samples were collected and analyzed for estimation of pH, EC, OC and available N, P, K, Mn, Zn, Fe and Cu using standard procedures and the data are presented in table 1. The pH was recorded using pH meter. The electrical conductivity of soil was estimated using EC meter. The organic C in soil was estimated using Walkley and Black titration method (1939). The N was determined by alkaline potassium permanganate method of Subbiah and Asija, 1956. Soil available phosphorus was extracted by NaHCO_3 (pH 8.5) as described by Olsen *et al.*, (1954) and P in extract was determined by ascorbic acid method using spectrophotometer (Watnabe and Olsen, 1965). The soil potassium was extracted by neutral normal ammonium acetate and determined with the help of flame photometer as described by Muhr *et al.*, (1965). The

available micronutrients Zn, Cu, Fe and Mn were extracted by using 0.005 M diethylene triamine penta acetic acid, 0.01 M calcium chloride dehydrate and 0.1 M amine buffered at pH 7.3 (Lindsay and Norvell, 1978) and content were analyzed using atomic absorption spectrophotometer (AAS).

Growth and yield attributes

The plant height (cm), number of grains finger^{-1} , finger length (cm), number of finger plant^{-1} , number of branches plant^{-1} , number of productive tiller plant^{-1} , number of leaves plant^{-1} , leaf length (cm), leaf width (cm), leaf area index, grain yield (q ha^{-1}), straw yield (q ha^{-1}), biological yield (q ha^{-1}), harvest index (%) and test weight (weight of 1000 grains) were recorded using standard procedure.

Results and Discussion

The variations in the yield and growth parameters of brown top millet due to levels of fertilizer and row spacing are presented in table 2 and figure 1-15 and the results are interpreted and discussed with the supportive reasons here under following heads.

Plant height

The highest plant height (103.3 cm) was recorded with the application of 125 % of recommended dose of fertilizer which was significantly higher than 100 and 75 % of recommended dose of fertilizer. The plant height under 100 and 75 % of recommended dose of fertilizer was found at par with each other. Similar findings were also reported by many workers (Prakash and Singh, 2014; Prakasha *et al.*, 2018).

The highest plant height (106.9 cm) was recorded with the row spacing of 22.5 cm which was significantly higher than the row spacing of 30, 45 and 60 cm. It was found that

plant height of brown top millet significantly increased with narrowing the row space from 45 to 30 and 30 to 22.5 cm. A possible reason for increased plant height upon narrowing the row spacing is that the more number of plants per unit area increased both the photosynthesizing area and the volume of roots per unit soil surface, allowing the crop to improve the exploitation of environmental resources. Lower light interception, might be due to less inter-plant competition for light at wider row spacing, could have reduced assimilate production (Amjad and Anderson, 2006). Optimum planting density varies with climatic conditions, soil type, location, sowing time and varieties (Hulihalli and Shantveerayya, 2018).

Number of tillers plant⁻¹

The highest number of tillers (5.4) of brown top millet was found under 125% recommended doses of fertilizer which was on par with 100% recommended dose of fertilizer and significantly higher than 75% recommended dose of fertilizer. Similar findings were reported by Kumari *et al.*, (2015), however, Obeng *et al.*, (2012) didn't get response of fertilizer levels in number of tillers.

The highest number of tillers per plant (6.0) of brown top millet was found under row spacing of 60 cm which was significantly higher than row spacing of 45, 30 and 22.5 cm. It was found that number of tillers per plant of brown top millet significantly decreased with narrowing the row space from 60 to 45, 45 to 30 and 30 to 22.5 cm. Kumari *et al.*, (2015) was also observed similarly.

Number of secondary tillers plant⁻¹

The highest number of secondary tillers plant⁻¹ (5.3) of brown top millet was found when 125% recommended dose of fertilizer was

applied which was at par with 100 and 75% of recommended doses of fertilizer. The results were in accordance with Kashik and Gautham (1991); Pandey *et al.*, (1988); Yadav and Jangir (1997) and Hulihalli and Shantveerayya (2018).

The row spacing of 60 cm was recorded the highest number of secondary tillers plant⁻¹ (7.0) which was significantly higher than the row spacing of 45, 30 and 22.5 cm. It was found that number of secondary tillers plant⁻¹ of brown top millet significantly decreased with narrowing the row space from 60 to 45 and 45 to 30 cm. The results were in accordance with Ka; Pandey *et al.*, (1988); Yadav and Jangir (1997) and Hulihalli and Shantveerayya (2018).

Number of fingers plant⁻¹

Application of 125 % recommended dose of fertilizer recorded the highest number of fingers (9.9) per plant which was significantly higher than 75 and 100% of recommended doses of fertilizer. Number of fingers per plant increased significantly with each successive level of fertilizer doses. The results were in accordance with findings of Nigade and More (2013) that the higher doses of fertilizer applied to the crop resulted in an increase in no. of fingers in plant.

Row spacing of 60 cm recorded the highest number of fingers (11.2) per plant of brown top millet. Number of fingers per plant of brown top millet increased significantly with each successive level of row spacing. The results were in accordance with Dereje *et al.*, (2016), who reported significantly highest number of fingers of finger millet under 40 cm of row spacing. Similarly, Mahato and Adhikari (2017) reported maximum no. of tillers per plant with the row spacing of 20 cm.

Finger length

The result reveals that the application of 125 percent recommended dose of fertilizer recorded the highest mean finger length (16.3 cm) of brown top millet. The mean finger length of brown top millet was increased significantly with each successive level of fertilizer. The present results were in accordance with the results obtained by Choudhary *et al.*, (2002) who reported the higher finger length of pearl millet, when 60 kg per hectare of nitrogen was applied to the crop. Similarly Nigade and More (2013) reported the increase in finger length with proper doses of NPK applied to the crop. Contrary to this, Giana (2014) reported that the fertility levels did not bring significant variation in ear length of pearl millet.

The result reveals that the row spacing of 60 cm recorded the highest mean finger length (15.9 cm) of brown top millet. The mean finger length of brown top millet increased significantly with each successive level of row spacing. Similarly, Sonboir *et al.*, (2017) reported the higher length of panicle was observed in paddy with the row spacing of 20 cm which was in accordance with the results obtained in the present study.

Number of Leaves plant⁻¹

The result reveals that the application of 125 % recommended dose of fertilizer in brown top millet produced the highest number of leaves (11.5) per plant. The number of leaves per plant of brown top millet increased significantly with each successive level of fertilizer.

The data reveals that the row spacing of 60 cm produced the highest number of leaves (11.4) per plant of brown top millet. Significantly higher number of leaves of brown top millet was recorded with each

successive level of row spacing except row spacing of 30 and 45 cm which was at par with each other. The findings were in accordance with Chamroy *et al.*, (2015), who reported the highest number of leaves per plant of 13.6 with the wider spacing in maize. Also, Dona *et al.*, (2017) reported higher number of leaves per plant of maize when planted with the row spacing of 60 cm.

Leaf width

The data reveals that the highest leaf width (2.3 cm) was registered with 125 % recommended dose of fertilizer which was significantly higher than 75% of recommended doses of fertilizer and statistically at par with 100% of recommended doses of fertilizer. Korir (2019) also reported that the leaf width differs significantly with doses of fertilizer.

The data reveals that the highest leaf width (2.2 cm) of brown top millet was registered with row spacing of 60 cm. which was statistically at par with 45 cm row spacing and significantly higher than 22.5 and 30 cm row spacing. The row spacing of 45 cm was also recorded significantly higher leaf width of brown top millet in comparison to 22.5 and 30 cm. row spacing. However, Korir (2019) reported that spacing had no significant difference in leaf width.

Leaf length

The highest leaf length (18.1 cm) of brown top millet was recorded with 125 % recommended dose of fertilizer which was significantly higher than 75 and 100 % recommended dose of fertilizer. The significantly higher leaf length of brown top millet was also recorded with 100 % recommended dose of fertilizer in comparison to 75 % recommended dose of fertilizer. Similarly, Korir (2019) reported significant

difference in leaf length due to doses of fertilizer. The highest leaf length (17.5 cm) of brown top millet was recorded with 60 cm. row spacing which was significantly higher than 45, 30 and 22.5 cm. row spacing. It was also found that narrowing the row spacing significantly decreased the leaf length of brown top millet. However, Korir (2019) didn't find any significant difference in leaf length with the differences in the row spacing.

Leaf area index

The highest leaf area index (1.36) of brown top millet was recorded with 125 % recommended dose of fertilizer which was significantly higher than 75 and 100 % recommended dose of fertilizer. The significantly higher leaf area index of brown top millet was also recorded with 100 % recommended dose of fertilizer in comparison to 75 % recommended dose of fertilizer.

The highest leaf area index (1.49) of brown top millet was recorded with 60 cm. row spacing which was significantly higher than 45, 30 and 22.5 cm. row spacing. It was also found that narrowing the row spacing significantly increased the leaf area index of brown top millet.

It was found that narrowing the row spacing from 60 to 45, 45 to 30 and 30 to 22.5 cm significantly increased the leaf area index of brown top millet under 100 and 125% recommended dose of fertilizers, however, under 75% recommended dose of fertilizers, the leaf area index of brown top millet increased significantly with narrowing the row spacing from 45 to 30 cm and row spacing 45 cm is at par with 60 cm and 30 cm is at par with 22.5 cm.

It could be concluded from these results that the leaf area index of brown top millet responded significantly to higher doses of fertilizer i.e. 100 and 125% of RDF at each

level of row spacing. The leaf area index of brown top millet didn't respond to lower level of fertilizer i.e. 75% of RDF under wider row spacing i.e. 60 cm.

The leaf area index increased significantly with increasing the level of fertilizer from 75 to 100 and 100 to 125 % of recommended dose under 22.5 and 30 cm row spacing of brown top millet, however, the leaf area index under 45cm row spacing of brown top millet was increased significantly when level of fertilizer increased from 75 to 100% of RDF only and under 60 cm row spacing, from 100 to 125% of RDF only. Increasing fertilizer level from 100 to 125% of RDF under 45 cm row spacing and from 75 to 100% of RDF under 60 cm row spacing didn't produce any significant effect on the leaf area index of brown top millet.

It could be concluded from these results that narrowing the row spacing of brown top millet from 45 to 30 or 22.5 cm, responded significantly to each and all the levels of fertilizer under study.

Number of grains finger⁻¹

The result showed that the highest number of grains (519) per finger of brown top millet is found with the treatment 125 % recommended dose of fertilizer which was significantly higher than 75 and 100% recommended dose of fertilizer. Similar findings were reported by Ojha *et al.*, (2018).

The highest number of grains (485) per finger of brown top millet was found with the row spacing of 60 cm which was significantly higher than 45, 30 and 22.5 cm row spacing. Narrowing the row spacing of brown top millet from 60 to 45, 45 to 30 and 30 to 22.5 cm. significantly decreased the number of grains per finger. Ashraf *et al.*, (2015) was also reported similarly.

Biological yield

The results reveal that the treatment with 125% of recommended doses of fertilizer recorded significantly higher biological yield (53.3 q ha⁻¹) of brown top millet as compared to 75% of recommended doses of fertilizer and statistically at par with the treatment 100% of recommended doses of fertilizer. Jat *et al.*, (2002) also reported similarly.

The results reveal that the treatment with the spacing of 22.5 cm recorded significantly higher (68.3 q ha⁻¹) biological yield of brown top millet than 30, 45 and 60 cm row spacing. Narrowing the row spacing from 60 to 45, 45 to 30 and 30 to 22.5 cm. significantly increased the biological yield of brown top millet. Similarly, an increase in biological yield due to narrowing the row spacing was also reported by Ashraf *et al.*, (2015).

Grain yield

The highest grain yield (6.4 q ha⁻¹) of brown top millet was recorded with 125% of recommended dose of fertilizer which was significantly higher than 75 and 100% of recommended dose of fertilizer. Significant increase in grain yield was recorded with each successive level of fertilizer. Bhagchand and Gautam (2000) also reported similarly.

The highest grain yield (7.4 q ha⁻¹) of brown top millet was recorded with 22.5 cm row spacing which was significantly higher than 30, 45 and 60 cm. row spacing. The grain yield of brown top millet was increased significantly with narrowing the level of row spacing. Similar findings were also reported by Giana (2014).

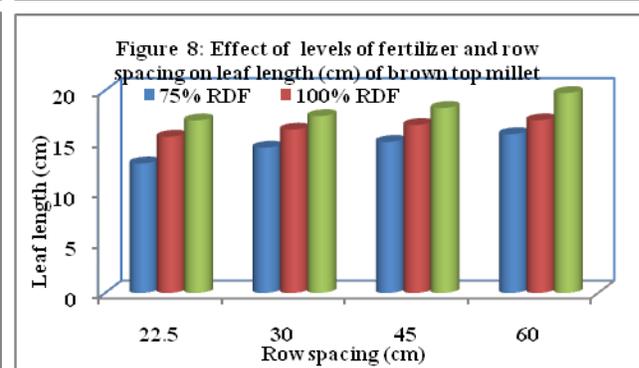
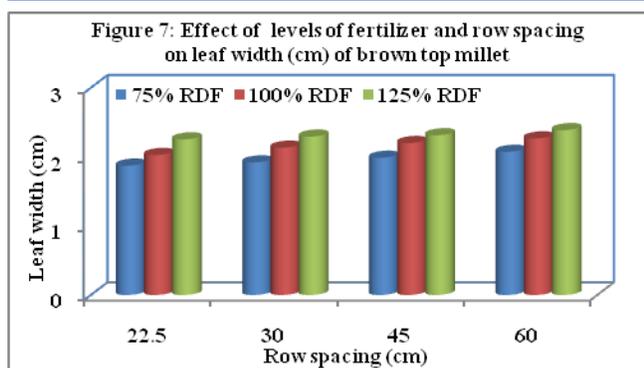
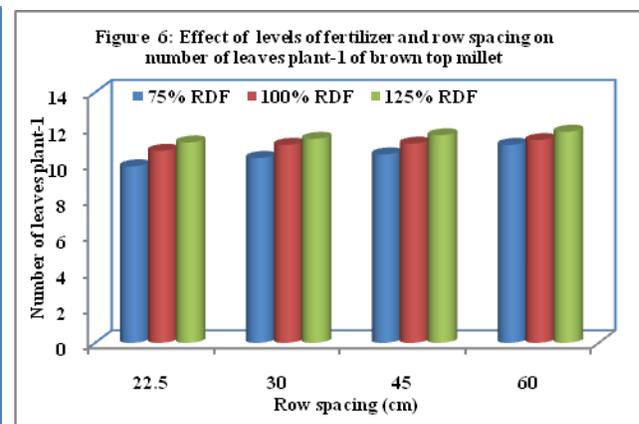
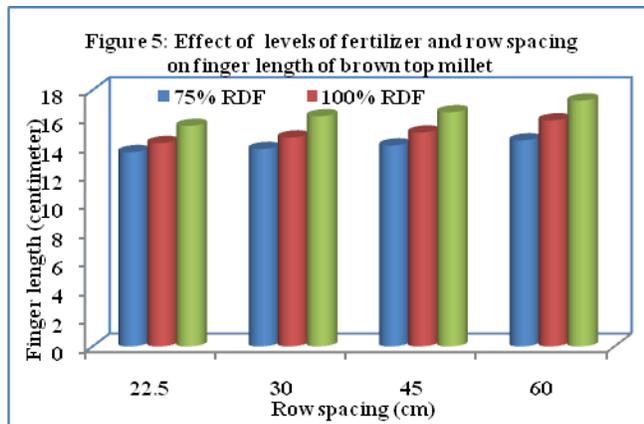
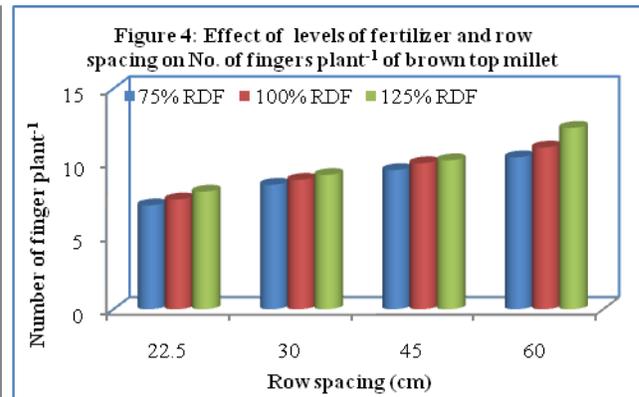
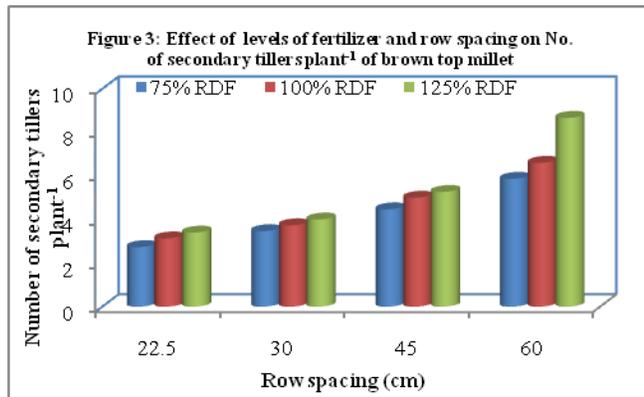
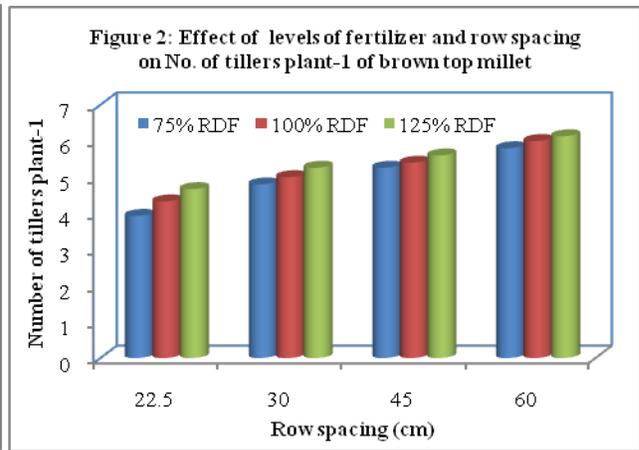
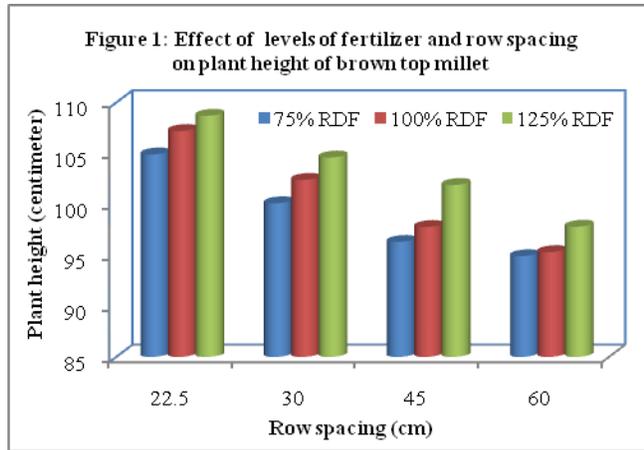
Table.1 Initial soil properties and nutrient status of experimental soil

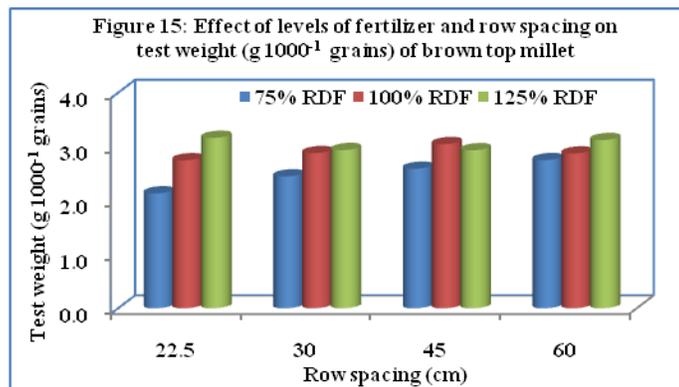
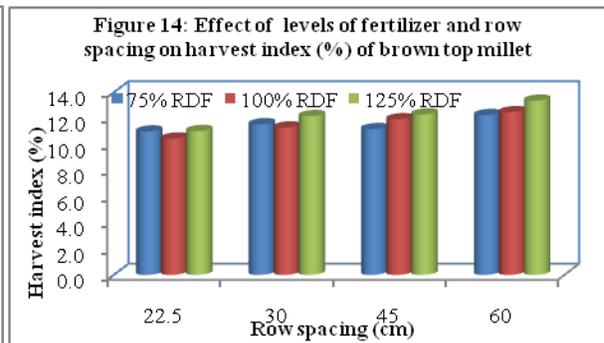
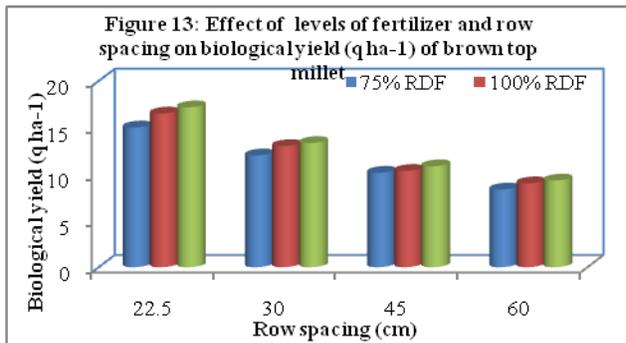
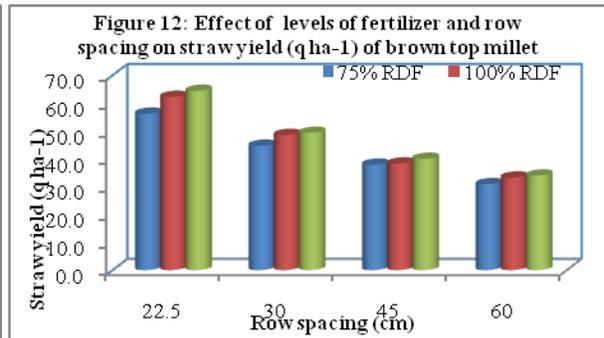
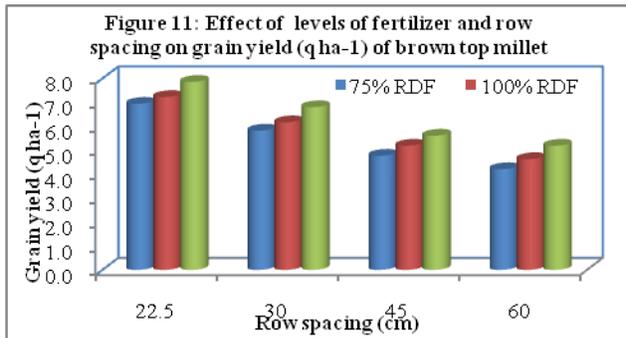
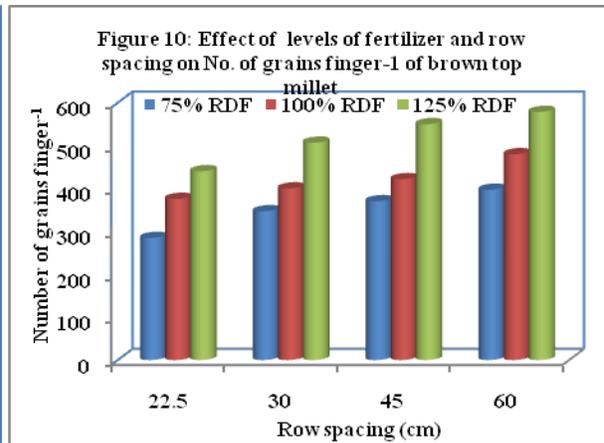
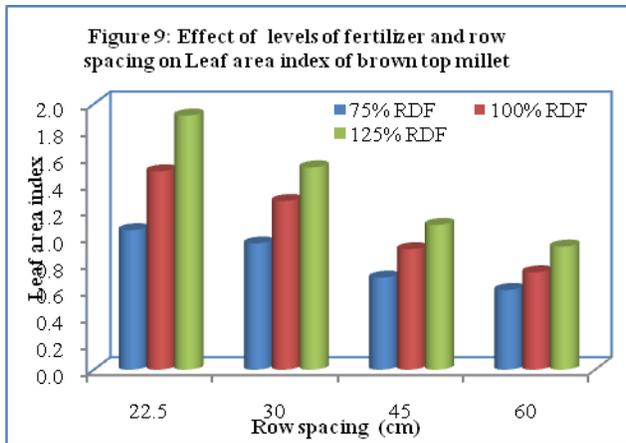
Soil properties	Initial status	Rating	Method
pH	5.86	Slightly acidic	pH meter
EC (dS m⁻¹)	0.10	Normal	EC meter
OC (%)	0.55	Medium	Walkley and Black (1939)
N (kg ha⁻¹)	163.07	Very low	Subbiah and Asija, 1956.
P (kg ha⁻¹)	10.75	Medium	Olsen <i>et al.</i> , (1954) and Watnabe and Olsen (1965)
K (kg ha⁻¹)	204	Medium	Muhr <i>et al.</i> , (1965) using flame photometer
Mn (mg kg⁻¹)	24.21	Sufficient	Lindsay and Norvell (1978) using AAS
Fe (mg kg⁻¹)	11.15	Sufficient	Lindsay and Norvell (1978) using AAS
Zn (mg kg⁻¹)	1.2	Sufficient	Lindsay and Norvell (1978) using AAS
Cu (mg kg⁻¹)	1.58	Sufficient	Lindsay and Norvell (1978) using AAS

Table.2 Effect of levels of fertilizer on yield and growth parameters of brown top millet in *Entisols* of Bastar plateau

S. No.	Yield and growth parameters of brown top millet	Fertilizer levels (% of RDF)			CD (P=0.05)	Row spacing (cm)				CD (P=0.05)
		75	100	125		22.5	30	45	60	
1.	Plant height (cm)	99.1 ^a	100.3 ^a	103.3 ^b	1.7	106.9	102.4	98.2	96	3.5
2.	Number of tillers plant ⁻¹	5.0 ^a	5.2 ^{ab}	5.4 ^b	0.26	4.3	5.0	5.4	6.0	0.20
3.	Number of secondary tillers plant ⁻¹	4.1 ^a	4.6 ^a	5.3 ^a	NS	3.1	3.7	4.9	7.0	0.99
4.	Number of fingers plant ⁻¹	8.8 ^a	9.3 ^b	9.9 ^c	0.42	7.5	8.8	9.8	11.2	0.56
5.	Finger length (cm)	14.0 ^a	15.0 ^b	16.3 ^c	0.50	14.5	14.9	15.2	15.9	0.24
6.	Number of leaves plant ⁻¹	10.5 ^a	11.1 ^b	11.5 ^c	0.34	10.6	10.9	11.1	11.4	0.21
7.	Leaf width (cm)	2.0 ^a	2.2 ^{ab}	2.3 ^b	0.21	2.1	2.1	2.2	2.2	0.05
8.	Leaf length (cm)	14.4 ^a	16.3 ^b	18.1 ^c	0.70	15.1	16.0	16.6	17.5	0.40
9.	Leaf area index	0.82 ^a	1.10 ^b	1.36 ^c	0.16	1.49	1.25	0.90	0.75	0.06
10.	Number of grains finger ⁻¹	350 ^a	419 ^b	519 ^c	56.0	367	418	447	485	25.0
11.	Biological yield (q ha ⁻¹)	47.8 ^a	51.4 ^b	53.3 ^c	0.98	68.3	53.8	43.9	37.4	5.16
12.	Grain yield (q ha ⁻¹)	5.4 ^a	5.8 ^b	6.4 ^c	0.15	7.4	6.3	5.2	4.7	0.39
13.	Straw yield (q ha ⁻¹)	42.4 ^a	45.6 ^b	46.9 ^c	1.01	60.9	47.5	38.7	32.7	5.19
14.	Harvest index (%)	11.5 ^a	11.5 ^a	12.2 ^b	0.18	10.8	11.7	11.8	12.7	NS
15.	Test weight (g 1000 ⁻¹ grains)	2.5 ^a	2.9 ^b	3.0 ^b	0.11	2.7	2.8	2.9	2.9	NS

CD=Critical difference, P=Probability level of significance, NS=Not significant, RDF=Recommended dose of fertilizer, cm=centimeter, Same small letters superscripted to data are at par as per Duncan's multiple range test.





Straw yield

The results reveal that the treatment with 125% of recommended doses of fertilizer recorded significantly higher straw yield (46.9 q ha⁻¹) of brown top millet as compared to 75% of recommended doses of fertilizer and statistically at par with the treatment 100% of recommended doses of fertilizer. Thakur *et al.*, (2019) also reported similarly.

The results reveal that the treatment with the spacing of 22.5 cm recorded significantly higher (60.9 q ha⁻¹) straw yield of brown top millet than 30, 45 and 60 cm row spacing. Narrowing the row spacing from 60 to 45, 45 to 30 and 30 to 22.5 cm. significantly increased the biological yield of brown top millet. Similarly, an increase in fodder yield due decrease of the row spacing was also reported by Thakur *et al.*, (2019).

Harvest index

The harvest index (12.2%) of brown top millet was found significantly higher with 125% recommended dose of fertilizers as compared to 100% and 75% recommended dose of fertilizers. The result obtained was in accordance with Aghdam *et al.*, (2014) where they found that the treatment had a significant effect on harvest index. In their experiment the highest harvest index 150 kg.ha⁻¹ was obtained from of urea as compared to non-urea fertilizer treatments. Similarly, Ojha *et al.*, (2018) reported the higher harvest index with the treatment 60:60:20 kg ha⁻¹ of NPK.

The harvest index of brown top millet was not influenced significantly with the levels of row spacing.

Test weight

The test weight of brown top millet was recorded statistically at par with 100 and

125% of recommended dose of fertilizes but both the doses produced significantly higher test weight of brown top millet as compared to 75% of recommended dose of fertilizes. Mukhtar *et al.*, (2011) also observed similarly that application of nitrogen and phosphorus at the rate of 250 kg N + 125 kg P₂O₅ ha⁻¹ to maize gave maximum 1000-grain weight. Tripathi and Kushwaha (2013) also reported similarly in case of pearl millet. Row spacing had no influence on test weight of brown top millet.

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