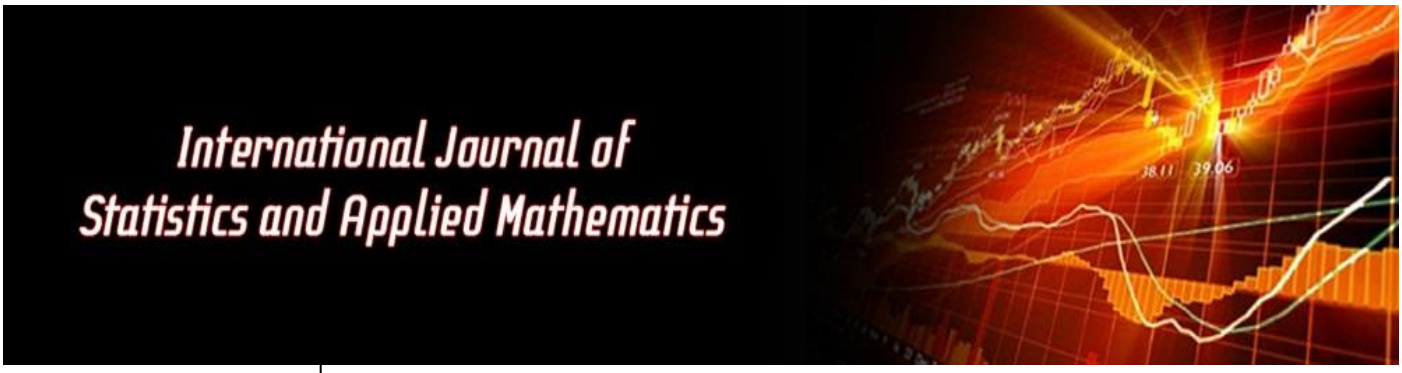

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Effect of land configuration and fertilizer on growth, yield attributing characters and yield analysis of caster grown in *Kharif* season of Marathwada region

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Abstract
The field experiment was conducted during rainy (*kharif*) season of 2017-18 at Experimental Farm, Agronomy Section, College of Agriculture, Latur. The experiment was laid out in Split plot design with three replications. The tremens comprised are Main plot treatment (Land configurations): L_1- Flat bed – 90 cm × 60 cm, L_2- Ridge and furrow – 90 cm × 60 cm, L_3-Flat bed with paired row spacing – (60 -120- 60 cm) × 60 cm, L_4-BBF with paired row spacing – (60 -120- 60 cm) × 60 cm and Sub-plot treatments (Fertilizer levels) F_1-75% RDF, F_2 - 100% RDF, F_3-125% RDF. The result indicated that the land configuration treatment ridges and furrows (L_2) recorded significantly increase growth and yield attributing characters and yield of castor *viz*. plant height, number of functional leaves plant^{-1}, number of branches plant^{-1}, leaf area plant^{-1}, total dry matter accumulation plant $^{-1}$, number of nodes plant^{-1}, stem girth plant^{-1}, number of spikes plant^{-1}, number of capsules plant^{-1}, seed yield plant^{-1}, test weight, seed yield, stalk yield and biological yield and which was found significantly superior over treatment flatbed (L_1) and treatment flat bed with paired row planting (L_3) and remained at par with treatment BBF with paired row planting (L_4) at all periodical days and at harvest except 30 DAS.
Similarly growth, yield attributing characters and yield of castor was observed higher in application of 125% RDF treatment (F_3) and which was found significantly superior over 75% RDF treatment (F_1), and found at par with 100% RDF treatment (F_2).

Keywords: Harvest except, tremens, attributing

Introduction
Castor belongs to Euphorbiaceace family and its seed is the source of castor oil, which has a wide variety of uses. As of now, more than 95% of the total castor cultivated area is under hybrids. During 2019–20, castor was cultivated in an area of 0.97 million ha, with a production of 1.95 million tones and productivity of 2010 kg/ha. Marathwada region is a erratic behavior of rainfall causes early-or late-season drought. In order to mitigate adverse effect of drought certain moisture-conservation practices are required for successful cultivation of crops under aberrant weather conditions.
The conservation of rainwater and its efficient use has been practiced in arid and semi-arid regions under dry land conditions with great success. During the rainy season, heavy downpour at short span of time leads to water stagnation which affects the spike formation and capsule development of castor, thereby proper land-configuration practices are required for easy and uniform germination as well as growth and development of plants. Land configuration is the alternation of shape of seedbed and land surface which helps in infiltration of rainfall, minimizing erosion, preventing runoff, facilitates drainage and ultimately improves water-use efficiency (Singh *et al*., 2017) [11]. Land configuration can be considered as one of the most important management practices which increases input-use efficiency and crop production but, it primarily depends on soil type and rainfall received during the cropping period (Kamble *et al.,* 2016) [8]. Fertilizers play vital role in maintaining / improving soil fertility status as the readily available nutrient to plants. Inadequate or excess supply of any plant nutrient limit may the crop production.

Among the plant nutrients, nitrogen and phosphorus are the most important and expensive nutrient and has marked effect on the plant growth in oil seed crop. Keeping these points in view, present investigation was carried out entitled "Response of castor *(Ricinus communis* L.) to fertilizer levels and plant geometry under different land configurations" was planned to find out appropriate land configuration and fertilizer dose for castor crop under dry land condition.

Materials and Methods

The experiment was conducted at during rainy (*kharif*) season of 2017-18 at Experimental Farm, Agronomy Section, College of Agriculture, Latur. The topography of experimental field was uniform and leveled. The soil of experimental site was deep, black in colour with good drainage. The chemical composition of experimental site indicated that soli was low in available nitrogen (165.00 kg ha^{-1}), medium in available phosphorus (17.50 kg ha^{-1}), very high in available potassium (464.06 kg ha^{-1}) content and alkaline in reaction having pH of 7.8. The mean annual precipitation was about 797.00 mm. most of the monsoon rains (78.54 per cent) received from June to September, having 27 rainy days. Normal temperature during experimental period was min. 11.6^{0}C and max. 31.7^{0}C.The experiment was laid out in Split plot design with three replications. The tremens comprised are Main plot treatment (Land configurations): L_1- Flat bed – 90 cm × 60 cm, L_2-Ridge and furrow – 90 cm × 60 cm, L_3-Flat bed with paired row spacing – (60 -120- 60 cm) × 60 cm, L_4-BBF with paired row spacing – (60 -120- 60 cm) × 60 cm and Sub-plot treatments (Fertilizer levels) F_1-75% RDF, F_2 - 100% RDF, F_3-125% RDF. The seeds of hybrid western 6 were sown at the depth of 5.0 cm. Sowing was done by dibbing 2-3 seeds per hill.

The ridge and furrow were prepared by using tractor drawn raised bed maker and flatbed were mad by bullock drawn implement manually.

The entire fertilizer applications as per the treatments in the form of urea, single super phosphate and muriate of potash was applied at the time of sowing and top dressing after 30 DAS. The fertilizers were applied in the form of a continuous band in rows and were covered with moist soil.

Results and Discussions

Land configuration

The data pertaining to the effect of various treatments on mean to be increasing progressively at every stage of crop growth till maturity. The mean number of functional leaves increased rapidly up to 120 days and thereafter decreased towards maturity to senescence of leaf, similar trend was observed in leaf area palant^{-1}. The mean number of branches increased at faster rate during the early stages of crop growth and there after the rate of increase of branches gradually decreased up to harvest.

Sowing of castor on land configuration treatment ridges and furrows (L_2) was found to be significantly superior in plant height, number of functional leaves plant^{-1}, number of branches, leaf area plant^{-1}, total dry matter accumulation plant $^{-1}$, number of nodes plant^{-1}, highest stem girth plant^{-1}, at 60, 90,120, 150 DAS and at harvest / at all the periodical days over treatment flat bed (L_1) and treatment flat bed with paired row planting (L_3) and remained at par with treatment BBF with paired row planting (L_4) presented in Table 1and 2.

The effect of land configurations on number of spikes plant^{-1}, number of capsules plant^{-1} and seed yield plant^{-1}, test weight was found to be significant presented in Table 3. The seed yield (131.52 g) plant^{-1}, seed yield (1502 kgha^{-1}), stalk yield kgha^{-1} biological yield kgha^{-1} sowing of castor on land congregation treatment ridges and furrows (L_2) was found to be at par with treatment BBF with paired row planting (L_4) (128.67 g) (1308 kgha^{-1}) and found significantly superior over treatment flat bed (L_1) and flat bed with paired row planting (L_3) (115.41g, 116.88g) (1047 kgha^{-1}) (1207 kgha^{-1}),similar trend was also found in Number of spikes plant^{-1}, number of capsules plant^{-1}, seed yield plant^{-1} 100 seed weight (Test weight).

The difference in plant height may be due to difference in moisture content of the soil. Similar findings were reported earlier by Guled *et al.* (1998) [4], Hari Ram *et al.* (2011) [5] and Bhople *et al.* (2018) [2]. The conserved moisture involved in metabolic or chemical reactions in plant and play an important role in photosynthesis resulted in higher number of leaves and leaf area plant^{-1}. This might be due to comparatively more availability of moisture and plays important role in plant metabolism for vegetative growth. More vegetative growth resulted in more number of branches and number of functional leaves and leaf area per unit area. The results were in conformity with the finding reported by Guled *et al.* (1998) [4].

It might be due to overall improvement in the crop growth with the efficient utilization of available moisture which empowered the plant to manufacture more quantity of photosynthetic accumulating in the sink of the plant result in higher seed yield, biological yield. These findings are corroborative with those of Aruna and Sagar (2016) [1], Lomte *et al.* (2006) [9], and Bhople *et al.* (2018) [2].

Fertilizer levels

Application of fertilizers treatment significant influence on at 60, 90, 120 150 DAS and at harvest but remained non-significant at 30 DAS. Application of 125% RDF treatment (F_3) recorded significantly increase plant height, number of functional leaves, leaf area plant^{-1} (dm^2), dry matter accumulation plant^{-1}, number of nodes plant^{-1} and stem girth plant^{-1} and found superior over 75% RDF treatment (F_1) and which was found at par with 100% RDF treatment (F_2), similar trend was observed during 90, 120,150 DAS and at harvest.

Application of 125%RDF treatment (F_3) was found significantly effective than 75% RDF (F_1) in increasing all growth and yield parameter. This might be mostly due to all the growth and yield parameters with higher levels of balanced fertilizer (NPK). The nitrogen promotes leaf, stem and other vegetative growth, produce rapid and early growth. Phosphorus stimulate early root development, flowering and aids in seed formation. Adequate supply of phosphorus in early stage helps in increasing number of branches for the reproductive plant parts. Whereas potassium helps in seed development, improves the quality of final products. These activities of nitrogen, phosphorus and potassium are responsible for better growth and yield attributes

The yield attributing character *viz.* number of spikes plant^{-1}, number of capsule plant^{-1}, seed yield plant^{-1} and seed index (g) were influenced significantly due to different fertilizer levels. Similar findings were recorded by Srivastava and Singh (2009) and Jadhav and Deshmukh (2008) [6].

Application of 125% RDF treatment (F_3) resulted in higher number of spikes plant^{-1}, number of capsules plant^{-1}, seed yield plant^{-1} (3131.28 g), test weight seed yield (1473 kgha^{-1}), stalk yield and biological yield which was found significantly

superior over 75% RDF treatment (F_1) (115.11g), (1062. kgha^{-1}) and at par with 100% RDF treatment (F_2) (122.97) (1263 kgha^{-1}).

Application of 125% RDF (F_3) recorded significantly higher seed yield (1473 kg ha^{-1}) over the 75% RDF (F_3) and found to be at par with 100% RDF (F_3). This might be due to higher growth and yield contributing characters with higher levels of fertilizers which results in increasing the final yield. The similar results were obtained by Shrivastava (1996), Aruna and Sagar (2016) [1] and Dhage (2009).

Table 1: Effect of land configurations and fertilizers levels on plant height, branches and number of functional leaves, leaf area of castor plant^{-1}

	Plant height						Branches						Number of functional leaves						Leaf area (dm^2)					
	30	60	90	120	150	AH	30	60	90	120	150	AH	30	60	90	120	150	AH	30	60	90	120	150	AH
(A) Land configurations (L)																								
L_1- Flat bed 90 x 60	12.0	36.8	118.7	126.5	129.1	134.7	1.67	3.04	4.16	4.78	4.98	5.09	4.76	12.69	26.04	43.22	19.49	12.00	8.30	37.6	72.2	96.9	30.2	15.2
L_2- Ridges and furrows 90 x 60	13.8	42.3	129.7	135.8	141.1	149.2	1.98	3.49	4.82	5.69	5.71	6.07	5.20	19.78	32.38	51.07	23.90	13.38	12.2	65.1	103.2	127.6	43.5	24.3
L_3- Flat bed with paired row spacing (60 -120-60) × 60	12.4	38.3	120.2	126.4	134.3	139.5	1.8	3.09	4.24	5.00	5.31	5.47	4.80	16.89	27.45	45.07	21.01	12.16	8.5	55.6	83.4	106.7	33.8	18.8
L_4- Broad bed furrow	13.2	41.0	123.3	130.8	141.4	144.7	1.84	3.31	4.51	5.29	5.51	5.82	5.18	18.47	31.31	48.94	21.92	12.98	10.5	62.6	94.2	121.7	42.6	22.8
SE(m)±	0.6	0.90	2.1	6.4	2.6	2.9	0.11	0.08	0.11	0.14	0.1	0.17	0.14	0.81	1.25	1.48	0.71	0.27	0.5	1.4	5.1	5.3	2.4	1.5
C.D. at 5%	NS	3.0	7.4	8.3	9.1	9.9	NS	0.26	0.37	0.47	0.35	0.58	NS	2.81	4.33	5.14	2.45	0.92	NS	4.9	17.6	18.3	8.1	5.1
(B) Fertilizer levels (F)																								
F_1- 75% RDF	12.0	37.5	118.2	130.5	130.5	137.4	1.67	2.93	4.05	4.78	4.65	4.98	4.85	15.63	27.10	43.16	20.03	11.83	9.2	43.7	72.2	92.2	31.3	15.7
F_2- 100% RDF	12.9	39.4	120.7	136.0	136.0	141.9	1.87	3.27	4.50	5.20	5.50	5.57	4.88	16.98	29.57	47.47	21.59	12.53	10.1	58.4	92.2	120.4	39.6	21.6
F_3- 125% RDF	13.6	41.9	129.8	143.0	143.0	146.8	1.93	3.50	4.75	5.58	5.98	6.28	5.22	18.25	31.27	50.60	23.12	13.52	10.4	63.7	100.3	127.0	41.6	23.5
SE(m)±	0.5	1.0	3.1	3.7	3.1	2.5	0.08	0.09	0.12	0.15	0.13	0.18	0.11	0.63	0.87	1.11	0.56	0.35	0.3	2.0	2.8	2.7	1.1	0.7
C.D. at 5%	NS	2.9	9.4	9.3	9.3	7.4	NS	0.28	0.35	0.46	0.38	0.54	NS	1.89	2.62	3.33	1.69	1.06	NS	6.0	8.5	8.0	3.3	2.1
Interaction (L x F) SE(m)±	0.6	0.6	3.7		2.3	3.0	1.18	0.18	0.15	0.16	0.22	0.19	0.30	0.94	1.30	1.13	0.70	0.77	0.9	3.8	4.1	4.9	3.3	1.8
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
General Mean	12.9	36.9	122.9	129.9	136.5	142.0	1.82	3.23	4.43	5.19	5.38	5.61	4.98	16.96	29.31	47.08	21.58	12.63	9.9	55.2	88.2	113.2	37.5	20.3

Table 2: Effect of land configurations and fertilizers levels on dry matter, nodes and number of stem girth of castor plant^{-1}

	Total dry matter (g)						Nodes plant^{-1}						Stem girth (cm)					
	30	60	90	120	150	AH	30	60	90	120	150	AH	30	60	90	120	150	AH
(A) Land configurations (L)																		
L_1- Flat bed 90 x 60	11.98	42.7	97.5	109.9	120.0	125.8	3.29	7.27	10.44	13.64	17.20	18.10	1.51	2.18	5.39	9.17	9.71	7.89
L_2- Ridges and furrows 90 x 60	14.40	58.7	109.1	123.6	131.1	141.1	3.89	9.09	12.22	16.1	18.99	21.09	1.86	4.94	7.08	10.88	12.34	9.97
L_3- Flat bed with paired row spacing (60 -120-60) × 60	12.04	49.5	101.0	115.2	125.5	131.9	3.42	8.02	10.97	14..58	17.47	18.58	1.61	2.93	5.79	9.39	10.30	8.01
L_4- Broad bed furrow	13.28	57.0	107.0	118.0	127.9	138.1	3.52	8.54	11.71	15.22	18.40	20.07	1.84	4.29	6.77	10.57	11.69	9.07
SE(m)±	0.56	2.4	2.1	1.8	1.6	2.5	0.13	0.23	0.34	0.55	0.32	0.63	0.11	0.46	0.32	0.23	0.55	0.44
C.D. at 5%	NS	8.5	7.2	6.2	5.5	8.8	NS	0.80	1.19	1.90	1.11	2.18	NS	1.61	0.78	0.78	1.91	1.51
(B) Fertilizer levels (F)																		
F_1- 75% RDF	12.38	38.7	94.3	104.7	117.2	123.2	3.28	7.28	10.57	14.10	17.01	18.01	1.57	2.80	5.48	8.86	10.32	8.12
F_2- 100% RDF	12.89	53.0	104.6	118.6	126.0	134.7	3.65	8.47	11.27	14.93	18.08	19.21	1.72	3.81	6.37	10.37	11.07	8.86
F_3- 125% RDF	13.51	64.2	112.0	126.7	135.6	144.8	3.70	8.92	12.13	15.93	18.95	21.13	1.83	4.14	6.92	10.78	11.64	9.23
SE(m)±	0.34	1.6	2.4	2.7	2.9	3.0	0.13	0.16	0.34	0.41	0.44	0.52	0.01	0.15	0.19	0.22	0.26	0.23
C.D. at 5%	NS	4.7	7.2	8.2	8.8	9.1	0.21	0.49	101	1.24	1.32	1.57	NS	0.46	0.58	0.67	0.78	0.69
Interaction (L x F) SE(m)±	0.67	3.2	1.8	3.5	3.4	4.0	3.54	0.34	0.25	0.44	0.35	0.50	0.03	0.46	0.26	0.50	0.44	0.43
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
General Mean	12.93	52.00	116.7	116.2	126.2	134.2	3.54	8.22	11.32	14.99	18.01	19.46	1.71	3.59	6.26	10.00	11.01	8.74

Table 3: Effect of land configurations and fertilizers levels on number of spikes plant^{-1}, capsules plant^{-1}, Seed yield plant^{-1}, test weight (g) seed yield (kgha^{-1}), stalk yield (kgha^{-1}) biological yield (kgha^{-1}) of castor

	Number of spikes	number of capsules	Seed yield plant^{-1}	Test weight	seed yield	stalk yield	biological yield
(A) Land configurations (L)							
L_1- Flat bed 90 x 60	6.93	170.09	115.41	21.67	1047.00	1956.00	3003.00
L_2- Ridges and furrows 90 x 60	8.87	203.78	131.52	27.22	1502.00	2697.00	4200.00
L_3- Flat bed with paired row spacing (60 -120-60) × 60	7.07	178.18	116.88	24.22	1207.00	2269.00	3476.00
L_4- Broad bed furrow	7.89	195.26	128.67	25.22	1308.00	2537.00	3846.00
SE(m)±	0.30	4.21	2.85	0.70	70.70	121.30	87.00
C.D. at 5%	1.05	14.54	9.85	2.42	245.00	420.00	301.00
(B) Fertilizer levels (F)							
F_1- 75% RDF	6.75	173.18	115.11	21.75	1062.00	2019.00	3081.00
F_2- 100% RDF	7.82	187.46	122.97	24.75	1263.00	2298.00	3561.00
F_3- 125% RDF	8.35	199.83	131.28	27.25	1473.00	2777.00	4251.00
SE(m)±	0.20	4.50	2.91	0.61	33.60	47.80	67.00

C.D. at 5%	0.61	13.48	8.71	1.83	101.00	143.00	201.00
Interaction (L x F) SE(m)±	0.42	11.55	1.61	0.84	33.600	166.90	201.00
C.D. at 5%	NS	NS	NS	NS	NS	500.00	NS
General Mean	7.64	186.83	123.12	24.58	1266.00	2365	3631

Interaction

Interaction of effect land configurations and fertilizer levels on stalk yield was significant. Significantly highest mean stalk yield was recorded by the interaction of treatment BBF with paired row planting (L_4) and application of treatment 125% RDF (F_3) (9473 kg ha^{-1}). The treatment land configuration ridges and furrows (L_2 recorded the highest mean stalk yield (2697 $kgha^{-1}$) and among the fertilizer levels 125% RDF (F_3) recorded highest stalk yield (2777 $kgha^{-1}$).

Interaction effect of land configurations and fertilizer levels on stalk yield

P × F	F_1	F_2	F_3	Mean
L_1	5366	5468	6768	1956
L_2	7115	8147	9013	2697
L_3	5375	6970	8074	2269
L_4	6370	6992	9473	2537
Mean	2019	2298	2777	2365

SE(m)± = 166.9 C.D. at 5% =500

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