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Impact of Different Planting Geometry and Fertility Levels on Plant Growth and Selected Features of Hybrid Napier under Bastar Plateau Zone of Chhattisgarh

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A B S T R A C T

The field experiment was conducted during the year 2017-18 under Instructional cum Research Farm at S.G. College of Agriculture and Research Station, Jagdalpur, IGKV, Raipur (C.G). The experiment was laid out in split plot design with two factors namely different planting geometry and fertility levels with three replications. The result revealed that maximum plant height was recorded treatment G_1 (50 cm × 50 cm) in planting geometry and in case of fertility levels F_1 (120:60:30 NPK kg ha^{-1}) recorded taller plant. Whereas, CGR, RGR, and NAR, were found unaffected due to planting geometry and fertility levels. Leaf area, leaf area index, was recorded significantly maximum in G_3 (90 cm × 50 cm) and lowest was recorded in treatment G_1 (50 cm × 50 cm). Fertility levels, treatment F_1 (120:60:30 NPK kg ha^{-1}) recoded significantly highest leaf area and leaf area index. The green fodder yield kg $plot^{-1}$ and yield q $ha^{-1}$was recoded highest in G_3 (90 cm × 50 cm) in planting geometry and in case of fertility levels F_1 (120:60:30 NPK kg ha^{-1}) recorded maximum green fodder yield.

Introduction

Hybrid napier (*Pennisetum purpureum* x *P. americanum*) is a perennial, palatable and nutritious fodder plant is suitable for planting under varied soil and climatic conditions (Singh *et al.,* 2002). It is an inter-specific hybrid between bajra (*Pennisetum americanum* L.) and a selection of a common napier (*Pennisetum purpureum* Schum.). Hybrid napier (*Pennisetum purpureum Schum.* x *Pennisetum americanum* L.) is a highly valued for its abundant quality forage, round the year fodder availability, regenerative ability and suitability to silage and hay making. It yields up to 110-120 t ha^{-1} fresh fodder as a sole crop. Though, it requires moist regimes for optimum growth, but it can withstand drought for a short spell and regenerate with rains. It contains 8.7-10.2 % crude protein, 28-30.5% crude fibbers and 10-11.5 % ash on dry matter basis (Agrawal *et* *al.,* 2001). It has the potential to produce more dry matter per unit time than most other grasses, (Hanna, *et al.,* 2004). However, maintenance of optimum planting density is always a big problem to the farmers. Substandard plant density result in high weeds infestation, poor radiation use efficiency and low yield, while dense plant population on the other hand cause lodging, poor light penetration in the canopy reduce photosynthesis production due to shading of lower leaves and drastically reduce the yield (Lemerle *et al.,* 2006).

Optimum spacing would help in efficient utilization of solar energy with less competition for growth factors (Jithendra *et al.,* 2013). Application of nitrogen and phosphorus fertilizer may improve yield and nutritive value of such fodder. Nitrogen from urea is an important nutrient in increasing productivity of forage biomass. The response of N fertilizer on green forage yield, and protein content and, also enhances the growth of shoot and makes the fodder juicy that is essential for fodder crop. It has been reported that N fertilizer increased both the biomass yield and quality of jumbo grass (Khalid *et al.,* 2003).

Materials and Methods

The field experiment was conducted during the year 2017-18 under Instructional cum Research Farm, S.G. College of Agriculture and Research Station, Jagdalpur, IGKV, Raipur (C.G.). The experiment was laid out in split plot design with two factors namely planting geometry i.e. G_1 (50 cm × 50 cm), G_2 (70 cm × 50 cm), and G_3 (90 cm × 50 cm) and fertility levels viz.F_1 (120:50:30 NPK kg ha^{-1}), F_2 (100:50:25 NPK kg ha^{-1}), and F_3 (75:45:20 NPK kg ha^{-1}) with three replications. The main plot treatment consists planting geometry of three levels with three replications. Bastar plateau zone is comes under sub-humid climatic condition of Chhattisgarh. Kumhrawand is located at is located at Bastar district lies at 19º05'N latitude and 81º57'E longitudes. The investigation crop received 1104.4 mm rainfall during entire crop growth period. The maximum temperature varied from 31.4˚Cin fourth week of September and 26.8˚C in third week of July during 2017, The field was divided into twenty seven plots by keeping provision for drainage channels and distance to mark different replications as well as plots. Healthy, disease free and hybrid napier sleeps were used as planting material. Planting of hybrid napier sleeps was done on 21 July 2017. Fertilizers were applied as per treatment in each plot.

Full dose of phosphorus and, potassium and half dose of nitrogen were applied as a basal dose during planting of sleeps. Remaining nitrogen was applied as two split dose at 60 and 90 days after planting. Nutrients were applied in the form of urea, single super phosphate and mutate of potash. The napier grass were harvested at 30 day interval and six harvesting were done. Observation was recorded from randomly five plant selected of each plot selected sample plants in each treatment/replication and observed mean value used for statistical analysis. The data on the different growth and yield characters were collected and analyzed statically for analysis of variance (ANOVA) fallowing the method described by Gomez and Gomez (1984).

Results and Discussion

Plant height

The data pertaining to hybrid napier plant height at different stages of crop growth are presented in Table 1. The data reveals that plant height increased progressively with advancement of crop age and reached maximum at 90 DAP. Plant height recorded significantly highest in treatment G_1 (50 cm × 50 cm) at all the growth stages which were on par with G_2 (70 cm × 50 cm) in different planting geometry. The taller plant was recorded in geometry (50 cm × 50 cm) it might be due to competition for sunlight, space, CO_2, nutrient and water. The higher plant height in 30 cm spacing of sowing was mainly due to reduced competition within the inter-row spacing as compared 20 cm line sowing and lower nitrogen applied, (Shivprasad and Singh, 2017). In case of fertility levels, treatment F_1 (120:60:30 NPK kg ha^{-1}) recorded taller plant among different treatment of fertility but it was significantly recorded at par with treatment F_2 (100:50:25 NPK kg ha^{-1}) and smaller plant was recorded in F_3 (75:45:20 kg NPK ha^{-1}).

The taller plant on higher levels of nitrogen was mainly attributed to more availability and uptake of nitrogen by crop which resulted in more vegetative growth and increase in protoplasmic constituent and acceleration in the process of cell division, expansion and differentiation there by resulting in luxuriant growth, the findings of Agrawal *et al.*, (2005) and Tiwana and Puri (2005). Soni *et al.*, (1991) reported that in hybrid napier grass, the yield attributing parameters incased linearly with increasing nitrogen leaves.

Leaf area

Data related to leaf area as influenced by different treatments are presented in Table 2. The finding revealed that geometry G_3 (90 cm × 50 cm) recorded significantly higher leaf area over other treatment at different growth stages however, it was recorded similar result on G_2 (70 cm × 50 cm) at 60, 180 and 210 DAP. Whereas, fertility level recorded significantly maximum leaf area in treatment F_1 (120:60:30 NPK kg ha^{-1}) which was found at par with F_2 (100:50:25 NPK kg ha^{-1}) at 60 and 120 DAP.

Leaf area index

The data on leaf area index at different stages of crop growth are presented in Table 3. Leaf area index was gradually increased and reached maximum at 210 DAP. Geometry G_3 (90 cm × 50 cm) recorded significantly higher LAI at all the observational period and it was at par with G_2 (70 cm × 50 cm) at all the growth stages except 150 DAP. As regards to fertility levels, LAI had recorded higher in F_1 (120:50:30 NPK kg ha^{-1}) among all the treatment but it was found similar result with F_2 (100:50:25 NPK kg ha^{-1}) at 120 DAP and F_3 (75:45:20 NPK kg ha^{-1}) recorded lowest LAI during experimentation.

Crop growth rate

The data with regard to crop growth rate at different duration are given in Figure 1. The findings reveals that plant geometry and fertility levels were found unaffected at all the growth stages due to different planting geometry and fertility levels during experimentation, except at 120 and 150 DAP in fertility levels, F_1(120:50:30 NPK kg ha^{-1}) were found significantly maximum crop growth rate.

Relative growth rate

The RGR was calculated for the period between 60 – 90, 90 – 120, 120 -150, 150 -180 DAP and 130 – 210 DAP values are depicted in Figure 2. The finding revealed that different treatment of planting geometry and fertility levels were recorded almost similar values during observational period.

Net assimilation ratio

The figure presented in Figure 3. Reveals that net assimilation ratio was also not affected significantly due to different planting geometry and fertility levels.

Fig.1 Effect of deferent planting geometry and fertility levels on hybrid napier

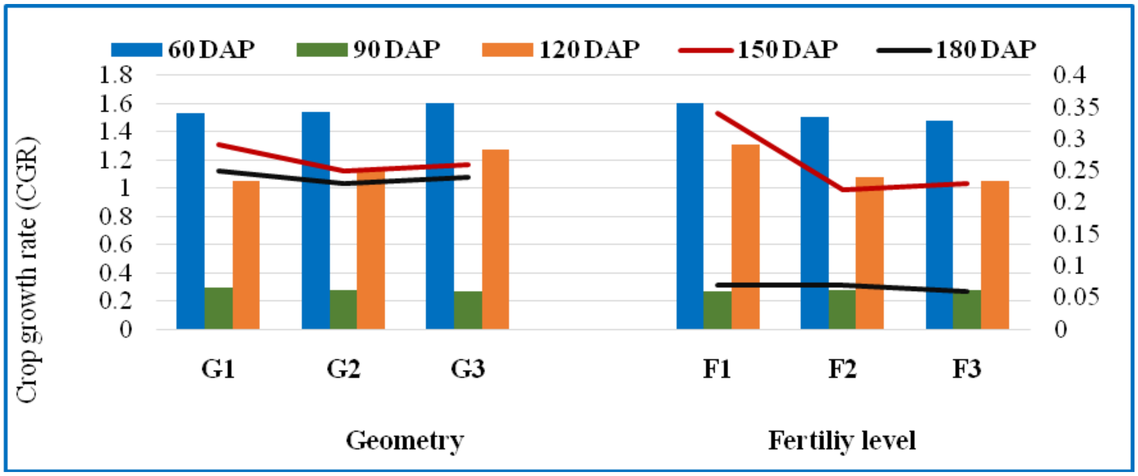

Fig.2 Effect of deferent planting geometry and fertility levels on hybrid napier

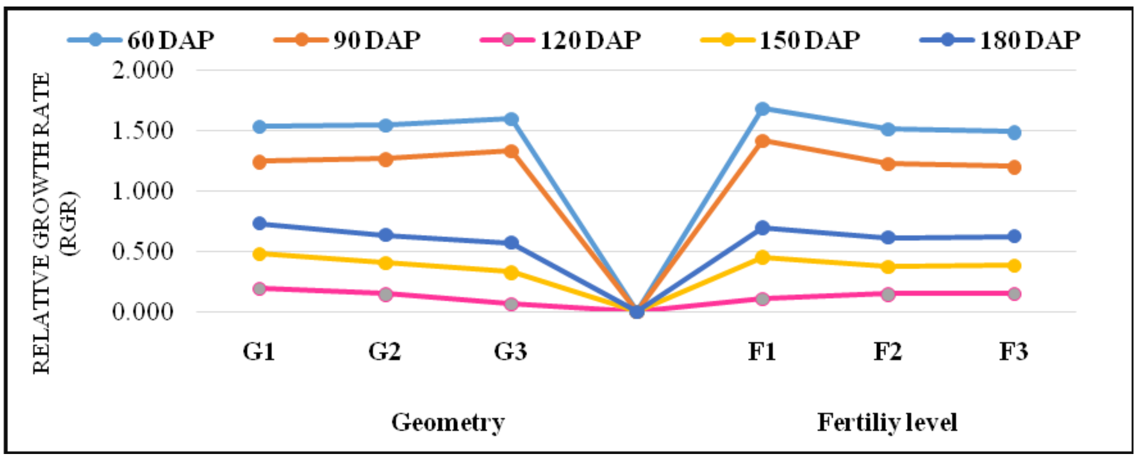

Fig.3 Effect of deferent planting geometry and fertility levels on hybrid napier

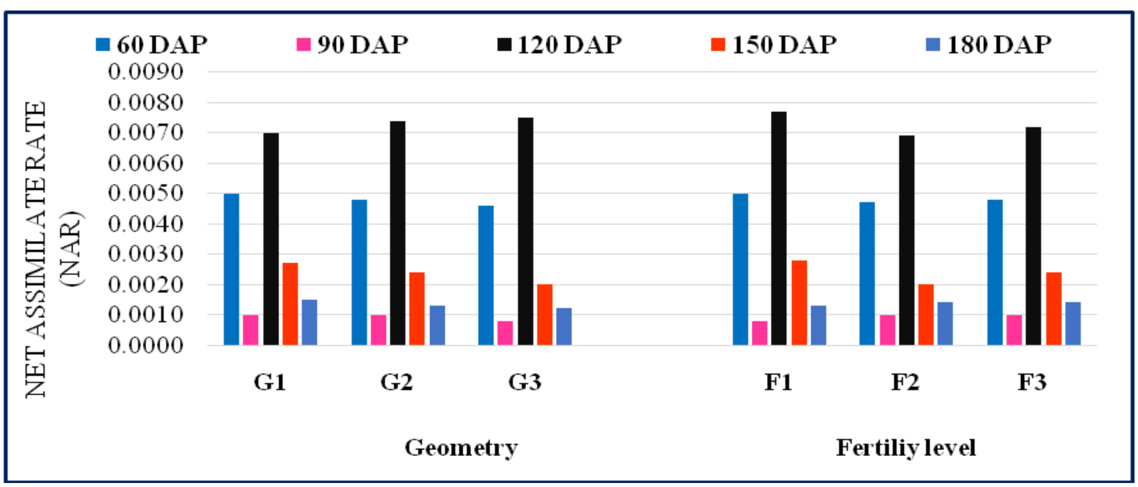

Table.1 Effect of different planting geometry and fertility levels on plant height of hybrid napier

Treatment	**Plant height (cm)**					
	60 DAP	**90 DAP**	**120 DAP**	**150 DAP**	**180 DAP**	**210 DAP**
			Planting Geometry			
G_1: 50 cm × 50 cm	108.13	182.64	164.32	72.78	70.12	91.48
G_2: 70 cm × 50 cm	104.57	175.40	149.49	68.60	66.87	86.72
G_3: 90 cm × 50 cm	98.11	162.02	146.08	65.60	62.80	82.73
SEm±	1.76	3.53	2.91	1.18	1.19	1.50
CD at 5%	7.09	14.22	11.72	4.76	4.81	6.05
CV %	5.09	6.10	5.68	5.14	5.38	5.17
			Fertility Levels			
F_1: 120:60:30 (NPK) Kg ha^{-1}	107.72	181.58	160.39	73.29	69.51	90.46
F_2: 100:50:25 (NPK) Kg ha^{-1}	102.53	171.11	152.56	68.67	66.52	86.47
F_3: 75:45:20 (NPK) Kg ha^{-1}	99.556	167.38	146.95	65.02	63.76	84.01
SEm±	2.00	3.31	2.93	1.21	1.13	1.64
CD at 5%	6.24	10.30	9.14	3.78	3.52	5.10
CV %	5.80	5.72	5.73	5.27	5.08	5.64

Table.2 Effect of different planting geometry and fertility levels on leaf area of hybrid napier

Treatment	**Leaf area (cm^2)**					
	60 DAP	**90 DAP**	**120 DAP**	**150 DAP**	**180 DAP**	**210 DAP**
			Planting Geometry			
G_1: 50 cm × 50 cm	104.98	163.79	108.46	40.35	51.97	94.56
G_2: 70 cm × 50 cm	116.60	165.67	108.68	41.69	57.42	106.77
G_3: 90 cm × 50 cm	124.03	181.08	118.65	46.83	64.28	113.92
SEm±	2.57	3.42	2.17	1.09	1.72	2.13
CD at 5%	10.36	13.79	8.75	4.40	6.94	8.58
CV %	6.69	6.02	5.81	7.61	8.91	6.07
			Fertility Levels			
F_1: 120:60:30 (NPK) Kg ha^{-1}	120.69	177.85	117.15	47.91	62.93	110.69
F_2: 100:50:25 (NPK) Kg ha^{-1}	114.80	168.85	112.25	42.84	57.75	104.47
F_3: 75:45:20 (NPK) Kg ha^{-1}	110.12	163.85	106.40	38.12	52.10	100.08
SEm±	2.03	2.85	1.90	1.01	1.42	1.79
CD at 5%	6.33	2.89	5.93	3.17	4.43	5.58
CV %	5.29	5.02	5.10	7.10	7.36	5.11

Table.3 Effect of different planting geometry and fertility levels on Leaf area index of hybrid napier

Treatment	Leaf area index (LAI)					
	60 DAP	**90 DAP**	**120 DAP**	**150 DAP**	**180 DAP**	**210 DAP**
			Planting Geometry			
G_1: 50 cm × 50 cm	1.80	1.10	2.45	1.49	2.40	4.30
G_2: 70 cm × 50 cm	1.93	2.07	2.61	1.71	2.58	4.65
G_3: 90 cm × 50 cm	2.02	2.25	2.71	1.83	2.63	4.72
SEm±	0.04	0.05	0.05	0.2	0.03	0.08
CD at 5%	0.16	0.18	0.18	0.06	0.12	0.32
CV %	6.16	6.37	5.32	2.66	3.52	5.00
			Fertility Levels			
F_1: 120:60:30 (NPK) Kg ha^{-1}	2.04	2.23	2.77	1.93	2.73	4.91
F_2: 100:50:25 (NPK) Kg ha^{-1}	1.91	2.11	2.58	1.64	2.52	4.52
F_3: 75:45:20 (NPK) Kg ha^{-1}	1.80	1.97	2.43	1.47	2.36	4.26
SEm±	0.04	0.04	0.06	0.05	0.07	0.08
CD at 5%	0.12	0.11	0.17	0.15	0.20	0.26
CV %	5.93	5.20	6.34	8.64	7.68	5.41

Table.4 Effect of different planting geometry and fertility levels on fodder yield of hybrid napier

Treatment	Green fodder Yield (q ha^{-1})						
	60 DAP	**90 DAP**	**120 DAP**	**150 DAP**	**180 DAP**	**210 DAP**	**Total green fodder**
		Planting Geometry					
G_1: 50 cm × 50 cm	67.78	109.18	81.83	49.40	59.93	73.26	441.38
G_2: 70 cm × 50 cm	71.24	112.55	82.61	51.08	61.77	78.50	457.75
G_3: 90 cm × 50 cm	77.02	121.66	88.87	57.73	67.32	88.06	500.67
SEm±	1.66	2.03	1.41	1.53	2.00	2.09	9.05
CD at 5%	6.70	8.19	5.69	6.16	NS	8.42	36.46
CV %	6.91	5.32	5.01	8.68	-	7.83	5.82
		Fertility Levels					
F_1: 120:60:30 (NPK) Kg ha^{-1}	75.86	119.33	90.00	56.40	66.63	84.88	493.11
F_2: 100:50:25 (NPK) Kg ha^{-1}	72.63	114.60	84.55	52.60	63.65	79.53	467.58
F_3: 75:45:20 (NPK) Kg ha^{-1}	67.54	109.45	78.75	49.21	58.74	75.41	439.11
SEm±	1.75	1.96	1.46	1.41	1.46	1.61	8.65
CD at 5%	5.44	6.10	4.53	4.39	4.55	5.02	26.93
CV %	7.27	5.13	5.16	8.01	6.95	6.04	5.56

Green fodder and total green fodder yield

Data on green fodder yield as influenced by planting geometry and fertility level are presented in Table 4. Treatment G_3 (90 cm × 50 cm) recorded significantly higher green fodder and total green fodder yield at 60 to 210 DAP and total fodder yield which was at par with G_2 (70 cm × 50 cm) at 60 DAP and lowest yield was recorded in G_1 (50 cm × 50 cm) which was due to the over burden of the plant population which compare for light and numerous leads to lanky growth and grass shoot appearance resulted in lower green fodder in (50 cm × 50 cm). This result conformity with the finding of (Shivprasad and Singh 2017). Fertility levels showed significantly variation in green fodder yield treatment F_1 (120:60:30 NPK kg ha^{-1}) recorded significantly higher green fodder yield at all the observational period and total green fodder yield, and it was found on par with F_2 (100:50:25 NPK kg ha^{-1}) at 60, 90, 150 and 180 DAP. The increased meristematic activity and photosynthetic area and cell division and elongation and hence more production and accumulation of photosynthesis, yield higher green fodder and dry matter reported by (Dudhat *et al.*, 2004). Increased fodder production with the application of nitrogen may be due to the better growth of plants as expressed in terms of plant height, number of tiller, fresh and dry weigh of fodder which was favorably affected by nitrogen on forage yield of oat, Ratan *et al.*, 2016, and it was also reported by Thakuria and Gagoi (2001), Sheoran *et al.*, (2002).

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References

Agarwal, S. B., Shukla, V. K., Sisodia, H.P.S., Tomar, T. and Shrivastava, A. 2005. Effect of inoculation and nitrogen levels on growth, yield and quality of fodder sorghum [*Sorghum bicolor* L. Moench] varieties. Forage Res., 31:106-108.

Agrawal, R. K., Singh, K. K. and Sharma, K. C. 2001. Effect of split application of nitrogen on the yield and quality of perennial grasses. Indian J. Anim. Nutri., 18 (3): 267-271.

Dudhat, M. S., Savalia, M. G. and Ramdevputra, M. V. 2004. Response of forage maize to nitrogen and phosphorus levels. Forage. Res., 30: 34-35.

Gomez, K. A. and Gomez, A. A. 1984. Statistical procedures for agricultural research. A Willey- Inter Sci. Publication. John Willey & Sons, NewYork.

Hanna, W. W., Chaparro, C. J., Mathews, B. W., Burns, J. C., Solenberger, L. E. and Carpenter, J. R. 2004. Perenialpennisetums. In L.E. Moser, B.L. Burson, and L. E. Sollenberger (Ed.). Warmseason (C4) grasses. Asa/Cssa/Sssa, Madison, Wi. Pp. 503-535.

Jithendra, D. B., Basvaraju, G.V. and Sarika, G. and Amrutha, N. 2013. Effect of fertilizer levels and planting geometry on growth and seed yield of single cross maize hybrid NAH-2049 (Nithyashree).G.J.B.A.H.S.,Vol.2(3): 216-220.

Khalid, M., Ijaz, A., and Muhammad, A. 2003. Effect of nitrogen and phosphorus on the fodder yield and quality of two sorghum cultivars (*Sorghum bicolor* L.). Int. J. Agri. Biol., 5(1): 61-63.

Lemerle, D., Verbeek. B. and Diffey, S. (2006). Influence of field pea (*Pisum sativum*) density on grain yieldand competitiveness with annual rye grass (*Lolim rigidum*) in south-eastern Australia. Australian Journal of Experimental Agriculture, 46: 1465-1472.

Ratan, N., Singh, U. N. and Pandey, H. C. 2016. Yield and quality of oat (*Avena sativa* L.) as influenced by nitrogen and varieties in Bundelkhand Region (U.P.) India. Agri. Sci. Res. J., 6(1): 27 – 30.

Sheoran, R. S., Rana, D. S. and Grewal, R. P. S. 2002. Influenced of azotobacter inoculation in conjunction with graded doses of nitrogen on forage yield of oats (*Avena sativa* L.). Forage Res., 28: 8 – 12.

Shivprasad, M. and Singh, S. 2017. Effect of planting geometry and different levels of nitrogen on growth, yield and quality of multicut fodder sorghum (*Sorghum bicolor* L.). Journal of Pharmacognosy and Phytochemistry, 6(4): 896-899.

Singh, D., Singh, V. and Joshi, Y. P. 2002. Herbage yield and yield attributes of napier bajra hybrid at different cuts as affected by cutting intervals and varying levels of nitrogen. Forage Res., 27 (4): 267-272.

Soni, K.C., Dalip, S. and Singh, D. 1991. Effect of nitrogen on the quality and green fodder yield of hybrid napier. Res. Dev. Reporter., 8:144-147.

Thakuria, K. and Gagoi, P. K. 2001. Performance of oat (*Avena sativa*) in rice (*Oryza sativa*) fallows under different levels of nitrogen and sowing method. Indian J. Agron., 46(2): 361-363.

Tiwana, U. S., Puri, K. P. 2005. Effect of nitrogen levels on the fodder yield and quality of pearl millet varieties under rainfed conditions. Forage Res., 31:142-143.

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