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INFLUENCE OF SOURCE OF PLANTING MATERIAL AND NUTRITION ON SEED YIELD AND QUALITY OF GUINEA GRASS (*PANICUM MAXIMUM* L.)

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SUMMARY

A field experiment was conducted at the Indian Grassland and Fodder Research Institute, Southern Regional Research Station, Dharwad to find out the effect of planting material and nutrition on seed yield and quality in guinea grass. The design employed was RBD in factorial concept with three replications. The experiment consisted of two planting materials *viz.,* seeds and root slips and five nutrient levels *viz.,* N_1: RDF (60:30:20 kg of NPK/ha), N_2: 25 % more than RDF, N_3: 50 % more than RDF, N_4: RDF + spraying of DAP 2 % at flowering stage, N_5: RDF + spraying of NAA 50 ppm at flowering stage. Among the planting material used, non-significant difference was observed for all growth and yield parameters, but root slips performed better over the seeds. Irrespective of planting material, nutrition levels recorded significantly. N_3 recorded more tiller number (14.77 at maturity), panicle length (32.8 cm), green fodder yield (13.21 q/ha), seed yield (95.24 kg/ha), seed germination (23.49 %) and seedling vigour index (216) compared to other nutrition levels.

Key words : Guinea grass, source, planting material, yield, quality, germination, seedling length

Guinea grass (*Panicum maximum*) is grown throughout tropical countries of both hemispheres where it plays important role in beef and dairy production. Parsons (1972) has plotted their spread from the guinea coast of West Africa to Barbodas during the seventeenth century and Brazil in the eighteenth century via slave ships. On a global scale, guinea grass is concentrated in Africa, Central and South America, Northern Australia, India, South- East Asia and the Pacific islands between 20 ^{0}N and 20 ^{0}S and above 1,300 mm rainfall isohyets. It ranges from sea level to approximately 2,000 m mostly scattered in tree grassland, open tall tree glades, coastal regions and bush vegetation. Guinea grass (cv. DGG-1) being a popular fodder grass of the tropics also suited to the diverse agro-climatic conditions of Karnataka. It can be profitably grown as a component of agro-forestry systems and comes up well under coconut and other trees. As an excellent fodder it is much valued for its high productivity, palatability and good persistence. It can be used as a long-term foraging grass and suitable for cut-and-carry, a practice in which grass is harvested and brought to a ruminant animal in an enclosed system. Shade tolerance makes it suited to coexisting with trees in agro-forestry. Intensive cropping is the only alternative to boost forage yield from irrigated lands and overall productivity which covers about 30 % of the cultivated area in the country. The crude protein and the crude fibre content of this grass vary from 8 to 14 per cent and 28 to 36 per cent, respectively. Being a perennial high yielding intensively cultivated fodder crop, propagated through both seed and vegetative propagules (root slips), establishment through root slips is highly successful and commonly practised. However, due to its bulkiness in both handling and transportation to cover larger areas, propagation through seed is a better alternative. However, this alternative also has the limitation of establishment (through nursery rising) and lower per cent of seed germination. Fast and synchronised germination is highly desirable to set successful forage grass pastures as well as to reduce the hazardous effects of weed species competition during the initial stages of seed germination. Nevertheless, most of the cultivated tropical forage grass species have low seed germination and variable seedling emergence periods (Herrera, 1994). Therefore, the seed technological research problems *i.e.,* mode of propagation and seed germination needs to be addressed to popularise the technology spread amongst the farming community. Besides these, soil nutrition plays a vital role in forage crop production and quality. Among the various factors, fertilizer requirement is very crucial in determining the yield and quality of fodder. The major nutrients namely, nitrogen, phosphorus and potassium form important components for the production and productivity of perennial grass species. These nutrients are also equally important for seed yield, seed quality and nutritive value of fodder with respect to crude protein, crude fibre, total digestible nutrients, *in vitro* dry matter digestibility *etc*. Earlier studies indicated the response of guinea grass to fertility levels and harvest intervals (Ram and Trivedi, 2013).

MATERIALS AND METHODS

The experiment was conducted during the year 2018-19 at Indian Grassland and Fodder Research Institute, Dharwad in factorial Randomised block design (RBD) with ten treatments replicated three times, the size of the gross plot was 4.5 m x 4.0 m and net plot was 3.5 m x 3.0 m.

In the present investigation ten treatment combinations involving two planting material, five levels of fertilizers application *viz.,* P_1N_1 : Seeds + RDF (60:30:20 kg of NPK/ha), P_1N_2 : Seeds + 25 % more than RDF (75:37.5:25 kg of NPK/ha), P_1N_3 : Seeds + 50 % more than RDF (90:45:30 kg of NPK/ ha), P_1N_4 : Seeds + RDF + spraying of DAP 2 % at flowering stage, P_1N_5 : Seeds + RDF + spraying of NAA 50 ppm at flowering stage, P_2N_1 : Root slips + RDF (60:30:20 kg of NPK/ha), P_2N_2 : Root slips + 25 % more than RDF (75:37.5:25 kg of NPK/ha), P_2N_3 : Root slips + 50 % more than RDF (90:45:30 kg of NPK/ha), P_2N_4 : Root slips + RDF + spraying of DAP 2 % at flowering stage and P_2N_5 : Root slips + RDF + spraying of NAA 50 ppm at flowering stage respectively. Observations were recorded on plant height (cm), number of leaves per plant, number of tillers per plant, number of panicles per plant, days to 50 per cent flowering, days to maturity and yield parameters *viz*., panicle length (cm), seed weight per panicle (g), seed yield per hectare (kg), seed recovery per cent, forage yield per hectare and seed quality parameters *viz*., Germination per cent, seedling dry weight (g), seedling vigour index and electrical conductivity. For the present study, freshly harvested seeds of guinea grass (*Panicum maximum)* cv. DGG-1 and root slips of size 10-12 cm were obtained from the Indian Grassland and Fodder Research Institute, Southern Regional Research Station, Dharwad.

Freshly harvested seeds are collected and used for raising nursery in plot of size 1.0 m^2. Seeds were sown to a depth of 1-2 cm, watered lightly thereafter once in two days. The seedlings were ready for transplanting at 35 days after sowing. In order to maintain recommended plant population as per treatments, gap filling was taken up after seven days of transplanting. The transplanting was done by planting uniform length, healthy, vigorous seedling, from nursery to main field at a spacing of 60 cm x 60 cm. Irrigation was given immediately after transplanting at alternate day until the plants established and then with sprinkler as and when required. The data obtained were statistically analysed (Panse and Sukhatme, 1967).

RESULTS AND DISCUSSION

Growth Parameters

There was non-significant difference of planting material on plant height @ 50 per cent flowering was observed. Plant height was numerically highest (131.67cm) in P_2 (root slips) as compared to P_1 (seeds) (129.50 cm). Highly significant difference for plant height at 50 per cent flowering was observed due to nutrition treatments. Among the nutrition treatments N_3 (90:45:30 kg of NPK/ha) recorded highest plant height (146.65 cm) and was significantly superior over other treatments. Whereas, N_1 (60:30:20 kg of NPK/ha) recorded lowest plant height (120.33 cm). There was non-significant difference of interaction with planting material and nutrition on plant height at 50 per cent flowering. However, numerically higher plant height (147.90 cm) was recorded in the treatment combination of P_2N_3 (root slips with 90:45:30 kg of NPK/ha) and the lowest (119.93 cm) was recorded in P_1N_1 (root slips with 60:30:20 kg of NPK/ha) (Table 1). Plant height at maturity was non-significantly influenced by planting material. Numerically higher plant height (194.21 cm) was recorded in P_2(root slips) and lowest plant height (193.01 cm) was recorded in P_1 (seeds). Plant height at maturity was influenced significantly by nutrition levels. Higher plant height (205.18 cm) was recorded in N_3 (90:45:30 kg of NPK/ha) and significantly superior over other treatments, while lowest (186.32 cm) was recorded in N_1 (60:30:20 kg of NPK/ha). The interaction effect between planting material and nutrition management are found to be significant for plant height at maturity. Higher plant height (205.90 cm) was recorded in the treatment combination of P_2N_3 (root slips with 90:45:30 kg of NPK/ha),

TABLE 1

Effect of planting material and mother plant nutrition on plant height and no. of tillers in guinea grass cv. DGG-1

Treatments	Plant height at 50% flowering (cm)			Plant height at maturity (cm)			Plant height at harvesting (cm)			No of tillers per plant at 50 % flowering			No of tillers/ plant at maturity		
Fertilizers	P_1	P_2	Mean	P_1	P_2	Mean	P_1	P_2	Mean	P_1	P_2	Mean	P_1	P_2	Mean
Planting material															
N_1	119.93	120.73	120.33	185.44	187.20	186.32	191.20	192.56	191.88	12.63	12.80	12.71	13.20	13.26	13.23
N_2	130.93	132.53	131.73	195.32	196.90	196.11	206.56	207.40	206.98	14.16	14.43	14.30	15.00	15.2	15.10
N_3	145.40	147.90	146.65	204.46	205.90	205.18	221.03	221.90	221.46	15.93	16.30	16.11	16.86	17.2	17.03
N_4	124.36	128.56	126.56	188.90	189.53	189.21	196.30	197.23	196.76	13.33	13.63	13.48	13.90	14.0	13.95
N_5	126.86	128.43	127.65	190.93	191.50	191.21	198.80	199.43	199.11	13.60	13.76	13.68	14.13	14.2	14.16
Mean	129.50	131.67	130.58	193.01	194.21	193.60	202.78	203.70	203.24	13.93	14.18	14.05	14.62	14.77	14.70
Sources	S.Em. ±	CD @ 5%		S.Em. ±	CD @ 5%		S.Em. ±	CD @ 5%		S.Em. ±	CD @ 5%		S. Em±	CD @ 5%	
P	0.188	NS*		0.46	NS		0.20	NS		0.02	NS		0.02	NS	
N	0.297	0.88		0.73	2.20		0.33	0.99		0.04	0.12		0.03	0.10	
Interaction (P x N)	0.420	NS		1.04	NS		0.46	NS		0.05	NS		0.04	NS	

*NS: Non- significant

Planting material (P): P_1 = Seeds, P_2 = Root slips

Nutrition (N): N1 = 60:30:20 kg of NPK/ha (RDF), N_2 = 75:37.5:25 kg of NPK/ha (25% more than RDF), N_3 = 90:45:30 kg of NPK/ha (50 % more than RDF), N_4 = RDF + spraying of DAP @ 2% at flowering stage, N_5 = RDF + spraying of NAA @ 50 ppm at flowering stage.

TABLE 2

Effect of planting material and mother plant nutrition on no. of leaves, days to 50% flowering, days to maturity and panicle length in guinea grass cv. DGG-1

Treatments	No of leaves at 50% flowering			No of leaves at maturity			Days to 50% flowering			Days to maturity			Panicle length (cm)		
Fertilizers	P_1	P_2	Mean	P_1	P_2	Mean	P_1	P_2	Mean	P_1	P_2	Mean	P_1	P_2	Mean
Planting material															
N_1	198.2	201.6	199.9	202.0	204.4	203.2	72.0	71.3	71.6	129.0	128.3	128.6	30.4	30.7	30.5
N_2	213.9	214.9	214.4	217.8	218.6	218.2	73.3	72.6	73.0	130.6	130.0	130.3	31.2	31.5	31.3
N_3	224.5	226.8	225.7	230.1	231.6	230.8	74.3	74.0	74.1	131.3	130.6	131.0	32.7	33.0	32.8
N_4	200.4	200.9	200.7	204.6	207.4	206.0	72.3	71.6	72.0	129.3	129.0	129.1	30.5	30.8	30.7
N_5	199.5	201.7	200.6	205.5	206.5	206.0	72.6	72.3	72.5	129.6	129.3	129.5	30.9	30.9	30.9
Mean	207.3	209.2	208.2	212.0	213.7	212.8	72.9	72.4	72.6	130.0	129.4	129.7	31.1	31.4	31.24
Sources	S.Em. ±	CD @ 5%		S.Em. ±	CD @ 5%		S.Em. ±	CD @ 5%		S.Em. ±	CD @ 5%		S.Em. ±	CD @ 5%	
P	0.3	NS*		0.1	NS		0.24	NS		0.26	NS		0.078	NS	
N	0.5	1.5		0.3	0.9		0.38	1.15		0.41	1.23		0.123	0.369	
Interaction (P x N)	0.7	NS		0.4	NS		0.545	NS		0.58	NS		0.174	NS	

*NS: Non- significant.

Planting material (P): P_1 = Seeds, P_2 = Root slips

Nutrition (N): N_1 = 60:30:20 kg of NPK/ha (RDF), N_2 = 75:37.5:25 kg of NPK/ha (25% more than RDF), N_3 = 90:45:30 kg of NPK/ha (50% more than RDF), N_4 = RDF + spraying of DAP @ 2% at flowering stage, N_5 = RDF + spraying of NAA @ 50 ppm at flowering stage.

significantly superior over other treatments and lowest (185.44 cm) was recorded in P_1N_1 (seeds with 60:30:20 kg of NPK/ha) (Table 3). There was non-significant difference of planting material on plant height at harvesting. Plant height at harvesting was numerically highest (203.70 cm) in P_2 (root slips) as compared to P_1 (seeds) (202.78 cm). Highly significant difference for plant height at harvesting was observed due to nutrition treatments. Among the nutrition treatments N_3 (90:45:30 kg of NPK/ha) recorded highest plant height (221.46 cm) and was significantly superior over other treatments. Whereas N_1 (60:30:20 kg of NPK/ha) recorded lowest plant height (191.88 cm). There was non-significant difference of interaction with planting material and nutrition on plant height at harvesting. However, numerically higher plant height (221.90 cm) was recorded in the treatment combination of P_2N_3 (root slips with 90:45:30 kg of NPK/ha) and the lowest (191.20 cm) was recorded in P_1N_1 (root slips with 60:30:20 kg of NPK/ha) (Table 1). Increased in plant height at different growth stages of crop might be due to application of higher doses of nutrient fertilizers, more than recommended dose has increased plant height because nutrients are an integral part of all proteins, and are one of the main chemical elements required for plant growth, photosynthesis, and further due to apply of higher doses of fertilizers, thereby increasing the food reserves for plant metabolism, Similar results were also reported by Uma *et al.* (2009) in oat crop and results were in conformity with Ram and Trivedi (2013) in guinea grass.

Tiller numbers were significantly influenced by planting material. Higher tiller number (14.18) were recorded in P_2 (root slips) and they were significantly superior over other planting material (seeds) (13.93). Tiller numbers were non-significantly influenced by planting material at 50 per cent flowering. Numerically higher tiller number (14.18) were recorded in P_2 (root slips) and they were significantly superior over other planting material (seeds) (13.93). Tiller numbers were influenced significantly by nutrition levels. Higher tiller number (16.11) were recorded in N_3 (90:45:30 kg of NPK/ha) significantly superior over other treatments, while lowest (12.71) were recorded in N_1 (60:30:20 kg of NPK/ha). The interaction effect between planting material and nutrition management were found to be non-significant for tiller number at 50 per cent flowering. However, numerically higher tiller number (16.3) were recorded in the treatment combination of P_2N_3 (root slips with 90:45:30 kg of NPK/ha) and lowest (12.5) was recorded in P_1N_1 (seeds with 60:30:20 kg of NPK/ha) (Table 1). The planting material non-significantly influenced the tiller number at maturity. Numerically maximum tiller number (14.77) were noticed in P_2 (root slips). The minimum tiller number (14.62) were observed in planting material P_1 (seeds). The difference in tiller numbers due to different doses of fertilizers at maturity were highly significant. The treatment N_3 (90:45:30 kg of NPK/ha) produced more tiller number (17.03) and were significantly superior over other treatments whereas, the treatment N_1 (60:30:20 kg of NPK/ha) produced least (13.23) tiller number at maturity. The interaction effect between planting material and nutrition management are found to be non-significant for tiller number at maturity. Numerically higher tiller number (17.2) were recorded in the treatment combination of P_2N_3 (root slips with 90:45:30 kg of NPK/ha) and lowest (13.2) were recorded in P_1N_1 (seeds with 60:30:20 kg of NPK/ha) (Table 1). Planting material did not vary significantly the number of leaves at 50 per cent flowering. Higher leaf number (209.2) were recorded in P_2 (root slips) and they were significantly superior over other planting material (seeds) (207.3). Number of leaves were influenced significantly by nutrition levels. Higher leaf number (225.7) were recorded in N_3 (90:45:30 kg of NPK/ha) significantly superior over other treatments, while lowest (199.9) were recorded in N_1 (60:30:20 kg of NPK/ha). The interaction effect between planting material and nutrition management were found to be non-significant for leaf number at 50 per cent flowering. However, numerically higher leaf number (226.8) were recorded in the treatment combination of P_2N_3 (root slips with 90:45:30 kg of NPK/ha) and lowest (198.2) was recorded in P_1N_1 (seeds with 60:30:20 kg of NPK/ha) (Table 2). The planting material non-significantly influenced the leaf number at maturity. The maximum number of leaves (213.7) were noticed in P_2 (root slips). The leaf number (212) were observed in planting material P_1 (seeds). The difference in leaf number due to different doses of fertilizers at maturity was highly significant. The treatment N_3 (90:45:30 kg of NPK/ha) produced more leaves (230.8) and were significantly superior over other treatments whereas, the treatment N_1 (60:30:20 kg of NPK/ha) produced least (203.2) leaf number at maturity. The interaction effect between planting material and nutrition management are found to be non-significant for leaf number at maturity. Numerically higher leaf number (231.6) was recorded in the treatment combination of P_2N_3 (root slips with 90:45:30 kg of NPK/ha) and lowest (202) were

TABLE 3

Effect of planting material and mother plant nutrition on green fodder yield, seed weight, seed recovery and seed yield in guinea grass cv. DGG-1

Treatments	Green fodder yield (q/ha)			Seed weight/panicle (g)			Seed recovery (%)			Seed yield/hectare (kg)		
Fertilizers	P_1	P_2	Mean	P_1	P_2	Mean	P_1	P_2	Mean	P_1	P_2	Mean
Planting material												
N_1	10.10	10.48	10.29	0.944	0.961	0.952	20.7	21.0	20.8	81.27	81.27	81.27
N_2	11.53	11.66	11.59	1.065	1.069	1.067	22.0	22.3	22.2	86.48	86.78	86.63
N_3	12.98	13.45	13.21	1.157	1.158	1.158	22.7	23.3	23.0	95.03	95.45	95.24
N_4	10.36	10.48	10.42	1.047	1.058	1.052	21.3	21.7	21.5	82.66	82.97	82.81
N_5	10.24	10.66	10.45	1.059	1.062	1.060	21.0	22.0	21.5	83.63	84.12	83.87
Mean	11.04	11.34	11.19	1.054	1.061	1.057	21.5	22.1	21.8	85.81	86.12	85.96
Sources	S.Em. ±		CD @ 5%	S.Em. ±		CD @ 5%	S.Em. ±		CD @ 5%	S.Em. ±		CD @ 5%
P	0.03		NS*	0.002		NS	0.22		NS	0.05		NS
N	0.05		0.15	0.003		0.009	0.35		1.05	0.08		0.254
Interaction (P x N)	0.07		NS	0.004		NS	0.49		NS	0.12		NS

*NS: Non- significant

Planting material (P): P_1 = Seeds, P_2 = Root slips

Nutrition (N): N_1 = 60:30:20 kg of NPK/ha (RDF), N_2 = 75:37.5:25 kg of NPK/ha (25 % more than RDF), N_3 = 90:45:30 kg of NPK/ha (50% more than RDF), N_4 = RDF + spraying of DAP @ 2% at flowering stage, N_5 = RDF + spraying of NAA @ 50 ppm at flowering stage.

recorded in P_1N_1 (seeds with 60:30:20 kg of NPK/ha) (Table 2). Increased in number of leaves and tillers at different growth stages of crop might be due to application of higher doses of nutrient fertilizers, increases the mobility of photosynthates, when higher doses of fertilizers applied there will be more rate of leaf expansion, rate of assimilate production per leaf area coupled with high nutrient intake, which may have translocated efficiently to tillers. Similar results were reported by Onyeonagu and Ugwuanyi (2012) recorded the highest plant height of 62.8 cm and maximum number of tillers of 16 when guinea grass was applied with 400 kg of nitrogen per ha. The influence on days to 50 per cent flowering due to planting material was non-significant. However, numerically minimum number of days to 50 per cent flowering (72.4) were recorded in P_2 (root slips) and maximum number of days to 50 per cent flowering (72.9) in P_1 (seeds). Days to 50 per cent flowering varied significantly due to different doses of nutrition. The treatment N_1 (60:30:20 kg of NPK/ha) took minimum days (71.6) to complete 50 per cent flowering, significantly varied among other treatments. Whereas, treatment N_3 (90:45:30 kg of NPK/ha) took the maximum days (74.1) for 50 per cent flowering. The interaction effect between planting material and nutrition management are found to be non-significant for days to 50 per cent flowering, However, numerically minimum number of days to 50 per cent flowering (71.3) were recorded in the treatment combination of P_2N_1 (root slips with 60:30:20 kg of NPK/ha) and maximum number of days (74.3) to 50 per cent flowering were recorded in P_1N_3 (seeds with 90:45:30 kg of NPK/ha) (Table 2). The influence on days to maturity due to planting material were non-significant. However numerically minimum number of days to maturity (129.4) were recorded in P_2 (root slips) and maximum number of days to maturity (130.0) in P_1 (seeds). Days to maturity varied significantly due to different doses of nutrition. The treatment N_1 (60:30:20 kg of NPK/ha) took minimum days (128.6) to complete maturity, significant varied among other treatments. Whereas treatment N_3 (90:45:30 kg of NPK/ha) took the maximum days (131.0) for maturity. The interaction effect between planting material and nutrition management are found to be non-significant for days to maturity. However, numerically minimum number of days to maturity (128.3) were recorded in the treatment combination of P_2N_1 (root slips with 60:30:20 kg of NPK/ha) and maximum number of days (131.3) to maturity were recorded in P_1N_3 (Seeds with 90:45:30 kg of NPK/ha) (Table 2). Days to 50 per cent flowering and days to maturity was significantly influenced by nutrient levels this might be due to application of higher doses of fertilizers, more than recommended dose has increased the number of days to 50 per cent flowering because higher nutrients prolonged the life cycle which extends the plant growth and delayed the flowering. Similar results were reported by Singh *et al.* (1999) in forage maize.

Yield parameters

Among planting materials used nonsignificant difference was observed with respect to panicle length but numerically higher panicle length (31.4 cm) was recorded in P_2(root slips) than P_1(seeds) (31.1 cm). A highly significant difference for panicle length was observed due to nutrition treatments. Among the nutrition treatments, N_3 (90:45:30 kg of NPK/ha) recorded highest panicle length (32.8 cm) and was significantly superior over other treatments. Whereas, N_1 (60:30:20 kg of NPK/ha) recorded lowest (30.5 cm) panicle length. There was non-significant difference of interaction with planting material and nutrition on panicle length. However, numerically higher panicle length (33.0 cm) was recorded in the treatment combination of P_2N_3 (root slips with 90:45:30 kg of NPK/ha) and the lowest (30.4 cm) was recorded in P_1N_1 (root slips with 60:30:20 kg of NPK/ha) (Table 2). Among the planting materials P_2 (root slips) recorded numerically higher fodder yield (11.34 q), whereas lowest fodder yield (11.04 q) was recorded in P_1 (seeds). Fodder yield per hectare differed significantly due to different doses of nutrient levels. Among the treatments, N_3 (90:45:30 kg of NPK/ha) recorded highest fodder yield (13.21 q) significantly superior over other treatments, while lowest (10.29 q) was recorded in N_1 (60:30:20 kg of NPK/ha). Fodder yield differed non-significantly due to interaction effect between planting material and nutrition management (Table 3). Seed yield per hectare differed non-significantly due to planting material. The planting material non-significantly influenced the seed weight per panicle at maturity. The maximum seed weight per panicle (1.061 g) was noticed in P_2 (root slips) and the minimum seed weight per panicle (1.054 g) was observed in P_1 (seeds). The difference in seed weight per panicles due to different doses of fertilizers at maturity was highly significant. The treatment N_3 (90:45:30 kg of NPK/ha) produced more seed weight per panicle (1.158 g) and was significantly superior

TABLE 4

Effect of planting material and mother plant nutrition on seed germination, vigour index, seedling dry weight and electrical conductivity in guinea grass cv. DGG-1

Treatments	Seed germination (%)			Vigour index			Seedling dry weight (mg/10 seedlings)			Electrical conductivity (dS/m)		
Fertilizers	P_1	P_2	Mean	P_1	P_2	Mean	P_1	P_2	Mean	P_1	P_2	Mean
Planting material												
N_1	19.83 (11.50)*	19.07 (10.66)	19.45 (11.08)	128	123	125	84.0	82.33	83.16	0.82	0.86	0.84
N_2	23.33 (15.66)	22.19 (14.25)	22.76 (14.95)	204	190	197	86.66	84.66	85.66	0.75	0.78	0.76
N_3	23.85 (16.33)	23.13 (15.41)	23.49 (15.87)	222	211	216	90.66	88.17	89.41	0.72	0.74	0.73
N_4	21.36 (13.25)	20.72 (12.5)	21.04 (12.87)	163	155	159	84.66	86	85.33	0.80	0.81	0.81
N_5	21.43 (13.33)	20.79 (12.85)	21.11 (12.95)	164	154	159	86.33	86	86.16	0.85	0.82	0.82
Mean	21.96 (14.01)	21.18 (13.08)	21.57 (13.54)	176	166	171	90.46	89.43	85.94	0.79	0.80	0.79

Sources	S.Em. ±	CD @ 5%	S.Em. ±	CD @ 5%	S.Em. ±	CD @ 5%	S.Em. ±	CD @ 5%
P	0.077	NS**	1.72	NS	0.313	NS	0.005	NS
N	0.121	0.363	4.30	36.42	0.494	1.48	0.008	0.02
Interaction (P x N)	0.171	NS	14.8	NS	0.699	NS	0.11	NS

*Arcsine transformed values *NS: Non- significant

Planting material (P): P_1 = Seeds, P_2 = Root slips

Nutrition (N): N_1 = 60:30:20 kg of NPK/ha (RDF), N_2 = 75:37.5:25 kg of NPK/ha (25% more than RDF), N_3 = 90:45:30 kg of NPK/ha (50% more than RDF), N_4 = RDF + spraying of DAP @ 2% at flowering stage, N_5 = RDF + spraying of NAA @ 50 ppm at flowering stage.

over other treatments whereas, the treatment N_1 (60:30:20 kg of NPK/ha) has produced least seed weight per panicle (0.952 g). The interaction effect between planting material and nutrition management are found to be non-significant for seed weight per panicle (Table 3). There was non-significant difference of planting material on seed recovery percentage but numerically highest (22.1 %) in P_2 (root slips) as compared to P_1 (seeds) (21.5%). Highly significant difference for seed recovery percentage was observed due to nutrition treatments. Among the nutrition treatments N_3 (90:45:30 kg of NPK/ha) recorded highest seed recovery percentage (23%) and was significantly superior over other treatments. Whereas, N_1 (60:30:20 kg of NPK/ha) recorded lowest (20.8 %) seed recovery percentage. There was non-significant difference of interaction with planting material and nutrition on seed recovery percentage. However, numerically higher seed recovery percentage (23.3 %) was recorded in the treatment combination of P_2N_3 (root slips with 90:45:30 kg of NPK/ha) and the lowest (20.7 %) was recorded in P_1N_1 (seeds with 60:30:20 kg of NPK/ha) (Table 3). Fodder yield per hectare differed non-significantly due to planting material. Among the planting materials P_2 (root slips) recorded numerically higher seed yield (86.12 kg), whereas lowest seed yield (85.81 kg) was recorded in P_1 (seeds). Seed yield per hectare differed significantly due to different doses of nutrient levels. Among the treatments N_3 (90:45:30 kg of NPK/ha) recorded highest seed yield (95.24 kg), it is significantly superior over other treatments, while lowest (81.27 kg) was recorded in N_1 (60:30:20 kg of NPK/ha). Seed yield per hectare differed non-significantly due to interaction effect between planting material and nutrition management. However, numerically higher seed yield (95.45 kg/ha) was recorded in the treatment combination of P_2N_3 (Root slips with 90:45:30 kg of NPK/ha) and lowest (95.45 kg) was recorded in P_1N_1 (Seeds with 60:30:20 kg of NPK/ha) and P_2N_1 (root slips with 60:30:20 kg of NPK/ha) (Table 3). This increase in yield parameters might be due to increase in the number of tillers which might have resulted the development of a greater number of reproductive parts and the increase in the sink size. Significant increase in sink size was also due to better dry matter partitioning, where higher doses might have resulted in increased translocation of photosynthates from source to sink and this also might be due to high NPK fertilizers, enhanced chlorophyll content and carbohydrate synthesis resulted higher accumulation of photosynthesis and their distribution to the developing ovules. The significant increase in all yield attributing characters with high level of nutrients was in conformity with the findings of Beena *et al.* (2011) in Berseem.

Seed quality parameters

Influence of planting material on seed germination per cent had non-significant effect. Numerically the highest (14.01 %) seed germination was recorded in P_2 (root slips) and lowest (13.08 %) seed germination P_1 (seeds). The difference in seed germination percentage due to nutrient levels was highly significant. The treatment N_3 (90:45:30 kg of NPK/ha) recorded highest germination (15.87%) and was significantly superior over other treatments whereas, the treatment N_1 (60:30:20 kg of NPK/ha) recorded lowest seed germination (11.08%). Influence on seed germination due to interaction of planting material and nutrient level was non-significant (Table 4). Vigour index was non-significantly influenced by planting material. Numerically higher vigour index (176) was recorded in P_2 (root slips) and lowest vigour index (166) P_1 (seeds). Vigour index was influenced significantly by nutrition levels. Higher vigour index (216) was recorded in N_3 (90:45:30 kg of NPK/ha) significantly superior over other treatments, while lowest (125) was recorded in N_1 (60:30:20 kg of NPK/ha).Interaction effect between planting material and nutrition management are found to be non significant for vigour index, However, numerically higher vigour index (222) was recorded in the treatment combination of P_2N_3 (rootslips with 90:45:30 kg of NPK/ha) and lowest (122.5) was recorded in P_1N_1 (seed with 60:30:20 kg of NPK/ha) (Table 4). The planting material treatment did not significantly influence the dry weight of seedlings. Numerically highest seedling dry weight (90.46 mg) was recorded in was recorded in P_2 (root slips) and lowest seedling dry weight (89.43 mg) P_1 (seeds). The difference in seedling dry weight due to nutrient levels was highly significant. The treatment N_3 (90:45:30 kg of NPK/ha) recorded highest seedling dry weight (89.41 mg) and was significantly superior over other treatments whereas, the treatment N_1 (60:30:20 kg of NPK/ha) recorded lowest seedling dry weight (83.16 mg). The influence on seedling dry weight due to interaction of planting material and nutrient level was non-significant (Table 4).EC did not vary significantly due to planting materials. The planting material P_1 (seeds) recorded numerically highest EC of seed leachate (0.80 dSm^{-1}) and lowest (0.79 dS/m) EC of seed leachate recorded in P_2 (root slips). The results differed significantly due to nutrient levels. The treatment N_1 recorded higher EC of seed leachate (0.84 dSm^{-1}) (60:30:20 kg of NPK/ha and significantly higher over other treatments, whereas lowest EC of seed leachate was recorded in N_3 90:45:30 kg of NPK/ha (0.73 dSm^{-1}). The influence on electrical conductivity of seed leachate due to interaction of planting material and nutrient level was non-significant (Table 4). An improvement in seed quality attributes may be attributed to the fact that providing adequate nutrition to the mother plant has reflected on seed quality attributes due to efficient accumulation and assimilation of photosynthates, Increase in germination of these seeds might be due to seeds that contain greater metabolites for resumption of embryonic growth during germination in addition to these metabolites certain enzymes that are also responsible for effective conversion of macromolecules into macromolecules within the seed during seed germination might have contributed increase in seed quality parameters due to certain changes in metabolic processes during seed development may also be associated with greater accumulation of food reserves resulting in higher seed quality traits. This was confirmed with the results of Beena *et al.* (2011) in Berseem.

CONCLUSION

Among the planting material used (seeds/root slips), non-significant differences were observed for all growth and yield parameters. Hence, any planting material (seed/root slips) can be used for establishing guinea grass. In guinea grass,90:45:30 kg of NPK/ha shown significantly higher in growth, yield and quality parameters over others.

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