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Research Article

EFFECT OF VARIETIES, CUTTING AND NITROGEN MANAGEMENT ON GRAIN YIELD AND YIELD PARAMETERS OF DUAL PURPOSE PEARL MILLET (*Pennisetum glaucum* L.)

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Abstract- A field experiment was conducted during *kharif* 2014 at ZARS, V. C. Farm, Mandya. The soil of the experimental site was red sandy loam with medium available NPK status. Experiment was laid out in RCBD with factorial concept replicated thrice. There were 12 treatment combinations involving 3 varieties (BAIF Bajra-1, AVKB-19 and GFB-1), two cuttings (Single cut at 45 DAS for green fodder and later for grain purpose and two cuts for green fodder at 45 DAS and at 40 days after first cut and later for grain purpose) and two nitrogen levels (100 and 150 kg ha^{-1}). The results revealed that, the variety BAIF Bajra-1 recorded significantly higher grain and stover yield (8.95 and 62.66 q ha^{-1}) compared to GFB-1 and AVKB-19. Single cut for green fodder followed by harvest for grain purpose has recorded significantly higher grain and stover yield (9.70 and 67.89 q ha^{-1}) compared to two cuts for green fodder followed by harvest for grain purpose. Application of 150 kg nitrogen ha^{-1} has recorded significantly higher grain and stover yield (8.81 and 61.68 q ha^{-1}) and superior over 100 kg nitrogen ha^{-1} (6.67 and 46.66 q ha^{-1}). The variety BAIF Bajra-1 with single cut for green fodder followed by harvest for grain purpose along with application of nitrogen 150 kg ha^{-1} recorded significantly higher grain and stover yield (13.84 and 96.86 q ha^{-1}). The variety BAIF Bajra-1 recorded significantly higher earhead length, earhead weight and earhead girth (37.24 cm, 18.93 g and 5.68 cm, respectively) compared to the variety GFB-1 (20.14 cm, 11.69 g and 5.67 cm, respectively) and AVKB-19 (19.15 cm, 8.66 g and 4.56 cm, respectively).

Keywords- Varieties, Cutting, Nitrogen, Dual purpose pearl millet.

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Introduction

Forages are the back bone of livestock industry. The foundation of animal health and their production depends on availability of green fodder. The scarcity of green forages and grazing resources in the country has made livestock to suffer from malnutrition resulted in decreasing production potentiality at below average compared to many developed countries.

India accounts about 520 million heads of livestock population, which contributed to 15 per cent of the world's livestock population, which supports about 55 per cent buffaloes, 16 per cent cattle's, 20 per cent goats and 4 per cent of sheep population. But, the area under forage crops is only 4.4 per cent of the cultivated area. In India the annual total forage production is 833 million tons (390 mt green and 443 mt dry fodders). Whereas, the annual requirement of forage is 1594 million tons (1025 mt green and 569 mt dry) to support the existing livestock population. The present feed and fodder resources of the country can meet only 48 per cent of the requirement, with a vast deficit of 52 per cent (61.1 per cent and 21.9 per cent of green and dry fodder) [1].

Although, India stands first in milk production (90 mt) in the world, but average milk yield is very low (5 litres/animal) compared to developed countries (24 litres/animal). Deficit supply of green fodder is one of the main reason for low milk yield along with other factors like imbalanced nutrition, good quality fodder. In India, due to increased population pressure and competition from the food crops for natural resources like land, water, sunlight etc., therefore it is not possible to increase the area under fodder crops further. The only way to bridge the large gap between demand and supply of fodder is through maximizing the fodder production per unit area and unit time. Another possibility is through better utilization of existing farming systems, utilizing marginal, sub marginal dry lands and problematic soils for developing fodder resources. Simultaneously efforts should be made in the genetic improvement of the livestock for better utilization of available fodder for most effectively, identification and introduction of new high yielding non traditional crops for green fodder and strategies to develop and adopt dual type grain-cum-fodder crop varieties to cater the demand of grain and fodder with available land resource.

At this juncture, Pearl millet (*Pennisetum glaucum* L.) is one of the important minor millets is being cultivated for high dietary fibre and nutrient source for human beings and also a good fodder crop for livestock. The dual purpose nature of pearl millet has been recently identified due to its profuse tillering, withstanding capacity for repeated harvesting, absence of anti nutritional factor like prussic acid and better performance under marginal and low fertile soils. Pearl millet, popularly known as poor mans crop due to its fair productivity even under lower management and multicut nature ensures the fodder supply year around and reduced cost of cultivation due to repeated cultivation like in single cut crops. In any fodder crop, the production potential can be improved by selection of high yielding varieties, fertilizer, cutting management. In this regard, scientific study on cutting and nitrogen management on green fodder yield, quality and grain yield of pearl millet is very meagre. Keeping these things in view the present study on Performance of dual purpose pearl millet (*Pennisetum glaucum* L.) varieties as influenced by cutting and nitrogen management was undertaken.

Material and Methods

The field experiment was conducted during *kharif* season of 2014 at Zonal Agricultural Research Station, Vishweswaraiah Canal Farm, Mandya (Karnataka) to assess the grain yield, stover yield and yield parameters of dual purpose pearl millet as influenced by cutting and nitrogen management. The soil of experimental field is red sandy loam with neutral soil pH (7.01), medium in available nitrogen (287.5 kg/ha), phosphorus (33.10 kg/ha) and potassium (143.81 kg/ha). The experiment was laid out in randomized complete block design with factorial concept with three replications. The experiment consisted of 12 treatment combinations *viz*., three varieties (BAIF Bajra-1, AVKB-19 and GFB-1), two cutting management practices (C_1-Single cut at 45 days after sowing for green fodder followed by harvest for grain purpose. C_2-Two cuts (1st at 45 days after sowing and 2nd at 40 days after 1st cut) for green fodder followed by harvest for grain purpose and two levels of nitrogen (100 and 150 kg N/ha). Equal quantity of farm yard manure at the rate of 10 t ha^{-1} was applied to each plot and mixed well in soil three weeks prior to sowing. Furrows were opened at 30 cm apart. 60 kg P_2O_5 ha^{-1} and 40 kg K_2O ha^{-1} were applied as per recommendation through single super phosphate and muriate of potash respectively. Nitrogen as basal 50% and remaining as top dress applied in two equal splits at 45 DAS and 85 DAS in the form of Urea. The fertilizers were applied in furrows and mixed properly. The crop was sown during first week of August and harvested when crop attained full maturity. Five plants were randomly selected in each net plot area for taking observations on growth and yield attributing parameters. The ears from net plot after air dried were threshed, cleaned and weight was recorded. Grain weight per net plot was converted into grain yield per hectare in quintals ha^{-1}. Fodder yield was recorded after complete sun drying of the fodder from each net plot and from this fodder yield per hectare was worked and expressed in quintals ha^{-1}. The length of ear head was measured from base to the tip of the ear and average of five tagged plants was taken as ear head length and expressed in centimeter (cm). Measurement at the middle of the ear was taken as the girth of the ear in centimeters. This was measured by placing the thread around the ear at middle portion and measured thread was placed on a scale to record girth of ear. The individual earheads were weighed separately from each treatment and the mean weight of five earheads were taken as the earhead weight and expressed in grams (g). The data were statistically analyzed for interpretation of results.

Results and Discussion

Grain and stover yield (q ha^{-1})

The variety BAIF Bajra-1 recorded significantly higher grain and stover yield (8.95 and 62.66 q ha^{-1}) and superior over the varieties GFB-1 (7.53 and 52.69 q ha^{-1}) and AVKB-19 (6.74 and 47.16 q ha^{-1}) respectively. The grain and stover yield eventually depends on the growth parameters and dry matter accumulation. Significant improvement in growth parameter like plant height, number of tillers and leaf: stem ratio, earhead length, earhead weight and earhead girth in variety BAIF Bajra-1 which finally contributed for higher grain and stover yield. Similar observations were observed [2,3].

Table-1 *Grain yield (q/ha) and Stover yield (q/ha) of dual purpose pearl millet varieties as influenced by cutting and nitrogen management*

Treatments	Grain yield (q/ha)	Stover yield (q/ha)	Treatments	Grain yield (q/ha)	Stover yield (q/ha)
Varieties (V)			**Interaction (C×N)**		
V_1	8.95	62.66	$C_1×N_1$	8.17	57.19
V_2	6.74	47.16	$C_1×N_2$	11.22	78.59
V_3	7.53	52.69	$C_2×N_1$	5.17	36.13
S.Em.±	0.21	1.45	$C_2×N_2$	6.40	44.78
CD @ 5%	0.61	4.24	S.Em.±	0.24	1.67
Cutting management (C)			CD @ 5%	0.70	4.90
C_1	9.70	67.89	**Interaction (V×C×N)**		
C_2	5.78	40.45	$V_1×C_1×N_1$	8.87	62.07
S.Em.±	0.17	1.18	$V_1×C_1×N_2$	13.84	96.86
CD @ 5%	0.49	3.46	$V_1×C_2×N_1$	5.70	39.90
Nitrogen level (N)			$V_1×C_2×N_2$	7.40	51.80
N_1	6.67	46.66	$V_2×C_1×N_1$	6.62	46.32
N_2	8.81	61.68	$V_2×C_1×N_2$	9.82	68.75
S.Em.±	0.17	1.18	$V_2×C_2×N_1$	4.65	32.55
CD @ 5%	0.49	3.46	$V_2×C_2×N_2$	5.87	41.07
Interaction (V×C)			$V_3×C_1×N_1$	9.03	63.19
$V_1×C_1$	11.35	79.47	$V_3×C_1×N_2$	10.03	70.19
$V_1×C_2$	6.55	45.85	$V_3×C_2×N_1$	5.13	35.93
$V_2×C_1$	8.22	57.52	$V_3×C_2×N_2$	5.92	41.46
$V_2×C_2$	5.27	36.82	S.Em.±	0.41	2.89
$V_3×C_1$	9.53	66.68	CD @ 5%	1.21	8.48
$V_3×C_2$	5.53	38.70	CV (%)	12.32	8.01
S.Em.±	0.29	2.05			
CD @ 5%	0.86	6.00			
Interaction (V×N)					
$V_1×N_1$	7.28	50.98			
$V_1×N_2$	10.62	74.33			
$V_2×N_1$	5.63	39.43			
$V_2×N_2$	7.85	54.90			
$V_3×N_1$	7.08	49.57			
$V_3×N_2$	7.98	55.83			
S.Em.±	0.29	2.05			
CD @ 5%	0.86	6.00			

V_1 : BAIF Bajra-1
V_2 : AVKB-19
V_3 : GFB-1

C_1: Single cut at 45 days after sowing for green fodder followed by harvest for grain purpose.
C_2: Two cuts (1st at 45 days after sowing and 2nd at 40 days after 1st cut) for green fodder followed by harvest for grain purpose.

N_1 : 100 kg Nitrogen ha^{-1}
N_2 : 150 kg Nitrogen ha^{-1}

Single cut for green fodder followed by harvest for grain purpose has recorded significantly higher grain and stover yield (9.70 q ha^{-1} and 67.89 q ha^{-1} respectively) as compared to two cuts for green fodder followed by harvest for grain purpose (5.78 q ha^{-1} and 40.45 q ha^{-1} respectively). Higher grain and stover yield of pearl millet under single cut for green fodder followed by harvest for grain purpose mainly due to higher plant height, number of tiller and leaf: stem ratio which contributed for higher grain and stover yield. In single cut for green fodder, crop could got sufficient time to accumulate more dry matter and better partitioning which resulted higher grain yield. All yield attributing parameters like earhead length, earhead weight and earhead girth finally contributed for higher grain yield.

The results are in agreement with Hooda *et al*., 2004 [4].

Application of 150 kg nitrogen ha^{-1} has recorded significantly higher grain and stover yield (8.81 and 61.68 q ha^{-1}) and superior over 100 kg nitrogen ha^{-1} (6.67 and 46.66 q ha^{-1}) respectively. Nitrogen application increased the grain and stover yield significantly. As the nitrogen levels increased from 100 to 150 ha^{-1}, grain and stover yield also increased significantly due to nitrogen helped in better utilization of potassium. Potassium directly involved in carbohydrate synthesis which results in bold seeds and test weight apart from increasing earhead length, earhead weight and earhead girth. The findings are in confirmation with Dilip Singh et al., 2012 [5]. The beneficial effects of nitrogen on cell division and elongation, formation of nucleotides and co-enzymes results in increased meristematic activity and photosynthetic area and hence more production and accumulation of photosynthates which reflects in the higher grain and stover yield.

The interaction effects, variety BAIF Bajra-1 with single cut for green fodder followed by harvest for grain purpose recorded significantly higher grain and stover yield (11.35 q ha^{-1} and 79.47 q ha^{-1}).

Table-2 *Yield parameters of dual purpose pearl millet varieties as influenced by cutting and nitrogen management*

Treatments	Earhead length (cm)	Earhead weight (g)	Earhead girth (cm)	Treatments	Earhead length (cm)	Earhead weight (g)	Earhead sgirth (cm)
Varieties (V)				**Interaction (C×N)**			
V_1	37.24	18.93	5.68	$C_1×N_1$	27.01	9.79	5.31
V_2	19.15	8.66	4.56	$C_1×N_2$	28.18	17.76	5.97
V_3	20.14	11.69	5.67	$C_2×N_1$	22.67	10.88	4.93
S.Em.±	0.88	0.49	0.18	$C_2×N_2$	24.19	13.97	5.01
CD @ 5%	2.58	1.44	0.54	S.Em.±	1.02	0.57	0.21
Cutting management (C)				CD @ 5%	NS	1.66	NS
C_1	27.59	13.77	5.64	**Interaction (V×C×N)**			
C_2	23.43	12.42	4.97	$V_1×C_1×N_1$	36.80	9.43	5.08
S.Em.±	0.72	0.40	0.15	$V_1×C_1×N_2$	39.27	23.83	6.21
CD @ 5%	2.11	1.18	0.44	$V_1×C_2×N_1$	35.22	17.93	5.64
Nitrogen level (N)				$V_1×C_2×N_2$	37.67	24.52	5.75
N_1	24.84	10.33	5.12	$V_2×C_1×N_1$	23.53	7.00	4.93
N_2	26.18	15.86	5.49	$V_2×C_1×N_2$	22.73	13.60	5.38
S.Em.±	0.72	0.40	0.15	$V_2×C_2×N_1$	13.67	6.39	4.14
CD @ 5%	NS	1.18	NS	$V_2×C_2×N_2$	16.67	7.65	3.78
Interaction (V×C)				$V_3×C_1×N_1$	20.70	12.92	5.91
$V_1×C_1$	38.03	21.23	5.70	$V_3×C_1×N_2$	22.53	15.83	6.31
$V_1×C_2$	36.45	16.63	5.65	$V_3×C_2×N_1$	19.11	8.30	5.00
$V_2×C_1$	23.13	10.30	5.15	$V_3×C_2×N_2$	18.22	9.73	5.52
$V_2×C_2$	15.17	7.02	3.97	S.Em.±	1.76	0.98	0.37
$V_3×C_1$	21.62	14.38	6.10	CD @ 5%	NS	NS	NS
$V_3×C_2$	18.67	9.02	5.27	CV (%)	11.95	12.99	12.06
S.Em.±	1.24	0.69	0.26				
CD @ 5%	3.65	2.04	NS				
Interaction (V×N)							
$V_1×N_1$	36.02	13.68	5.37				
$V_1×N_2$	38.47	24.18	5.98				
$V_2×N_1$	18.60	6.70	4.53				
$V_2×N_2$	19.70	10.63	4.58				
$V_3×N_1$	19.90	10.62	5.45				
$V_3×N_2$	20.38	12.78	5.92				
S.Em.±	1.24	0.69	0.26				
CD @ 5%	NS	2.04	NS				

V_1 : BAIF Bajra-1
V_2 : AVKB-19
V_3 : GFB-1

C_1: Single cut at 45 days after sowing for green fodder followed by harvest for grain purpose.
C_2: Two cuts (1st at 45 days after sowing and 2nd at 40 days after 1st cut) for green fodder followed by harvest for grain purpose.

N_1 : 100 kg Nitrogen ha^{-1}
N_2 : 150 kg Nitrogen ha^{-1}

The higher grain and stover yield of pearl millet in single cut for green fodder and followed by harvest for grain purpose might be attributed to higher growth and yield parameters *viz*., plant height, number of tillers contributed for higher stover yield. The single cut for green fodder and later for grain purpose would got longer period to accumulate more dry biomass and its partitioning in to grain and also higher earhead length, earhead weight and earhead girth which finally contributed to higher grain yield. The results are in confirmation with Hegde *et al*. (2004) [6] and Singh *et al*. (1993) [7].

Variety BAIF Bajra-1 with application of 150 kg ha^{-1} recorded significantly higher grain and stover yield (10.62 q ha^{-1} and 74.33 q ha^{-1}). This was mainly due to the variety BAIF Bajra^{-1} is more response to applied nitrogen by increasing plant height, number of tiller and leaf: stem ratio led to accumulation of more dry matter and partitioning to developing grains. Improvement in the growth parameters increased the stover yield.

The interaction effect of single cut for green fodder followed by harvest for grain purpose with application of nitrogen 150 kg ha^{-1} recorded significantly higher grain and stover yield (11.22 q ha^{-1} and 78.59 q ha^{-1}).

The interaction of variety BAIF Bajra-1 with single cut for green fodder followed by harvest for grain purpose along with application of 150 kg nitrogen ha^{-1} recorded significantly higher grain and stover yield (13.84 q ha^{-1} and 96.86 q ha^{-1}).

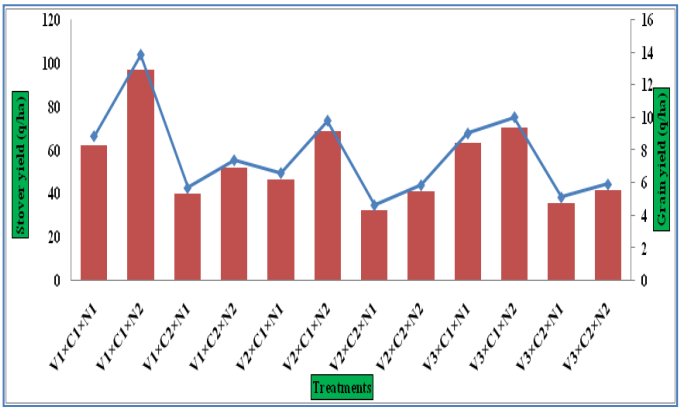

Fig-1 Grain and Stover yield of dual purpose pearl millet varieties as influenced by cutting and nitrogen management

Yield parameters

The variety BAIF Bajra-1 recorded significantly higher earhead length, Earhead weight and Earhead girth (37.24 cm, 18.93 g and 5.68 cm) and superior over the variety GFB-1 (20.14 cm, 11.69 g and 5.67 cm) and AVKB-19 (19.15 cm, 8.66 g and 4.56 cm) respectively.

Single cut for green fodder followed by harvest for grain purpose has recorded significantly higher earhead length, earhead weight and earhead girth (27.59 cm, 13.77 g and 5.64 cm) compared to two cuts for green fodder followed by harvest for grain purpose (23.43 cm, 12.42 g and 4.97 cm) respectively.

Application of nitrogen 150 kg ha^{-1} recorded longer earhead length (26.18 cm, 15.86 g and 5.49 cm) compared to nitrogen application 100 kg ha^{-1} (24.84 cm, 10.33 g and 5.12 cm) respectively.

The interaction of BAIF Bajra-1 with single cut for green fodder followed by harvest for grain purpose recorded significantly higher earhead length and earhead weight (38.03 cm and 21.23 g) due to efficient convert of biomass yield to increased yield attributing parameters like earhead length and earhead weight.

The interaction of variety BAIF Bajra-1 with application of nitrogen 150 kg ha^{-1} recorded significantly higher earhead weight (24.18 g). This was due to the ability to uptake more nitrogen, as nitrogen directly involved in uptake and utilization of potassium which eventually formation of starch in grain sufficiently utilize nitrogen.

The interaction of single cut for green fodder followed by harvest for grain purpose with nitrogen 150 kg ha^{-1} recorded significant higher earhead weight (17.76 g).

Conclusion

The variety BAIF Bajra-1 with single cut for green fodder followed by harvest for grain purpose along with application of 150 kg nitrogen ha^{-1} recorded significantly higher grain and stover yield. The interaction of BAIF Bajra-1 with single cut for green fodder followed by harvest for grain purpose has recorded significantly higher yield attributing parameters *viz.,* earhead length, earhead weight and earhead girth.

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Compliance with Ethical Standards:

Conflict of interest: The authors declare that they have no conflict of interest.

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

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