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Effect of Harvesting Stages N and P Levels on Forage Yield and Quality of Ratoon Pearl Millet

Pearl millet, (*Pennisetum typhoides*) a native of Africa was introduced into India a long back itself. The cultivation of pearl millet for forage purpose has recently been emphasized due to its profused tillering, multicut nature, absence of position 'prussic acid' and good performance even on poor soils. Pearl millet, popularly known as poor mans crop, is favorably productive under optimum management. However, the production potential depends on physiological growth stage and cutting at optimum stage during the growing season. Multicut nature of the crop ensures the forage supply over a long period of time, reduced cost of cultivation and many other benefits. This behavior of the crop, therefore, can be modified by manipulating the harvesting stage and fertilization practices to derive maximum benefits. Improper nutrition and right stage of harvesting limit the productivity and quality of forage. However, scientific study on forage yield and regeneration behavior with respect to cutting stage, nitrogen and phosphorus management is rather meager. Therefore, the present study was undertaken.

A field experiment was conducted at the Agricultural college farm, Dharwad under irrigated condition during the Kharif season 2001. The normal amount of rainfall in the region is 830 mm the region is transitional tract. The experiment was taken up to study the forage yield, quality and ratoonability of pearl millet as influenced by stage of harvesting, nitrogen and phosphorus levels. The experiment was laid out in a randomized block design with three factorial concept and replicated thrice. There were 12 treatments comprising of combinations of three stages of harvesting of the seed crop (Stage I-Harvesting at flag leaf stage, Stage II-Harvesting full flowering stage and Stage III- Harvesting at Milk stage) two nitrogen levels (N80 and N120 kg ha^{-1}) and two phosphorus levels (P_{40} and P_{60}) kg ha^{-1}. The soil was clayey in texture and black in colour with pH of 7.5. Total nitrogen 0.052 per cent, available P_2O_5 0.004 per cent and available K_2O 0.025 per cent. The variety used was DFB-1, harvesting of seed crop was done according to treatments (Flag leaf stage, full flowering stage and Milk Stage) and harvesting of ratoon crop was done at full flowering stage. The crop received nitrogen and phosphorus as per the treatments and a common dose of 40 kg K_2O per ha applied at the time of sowing. The fertilizer sources were urea, single super phosphate and muriate of potash. The yield and quality parameters were recorded at harvest. The data were statistically analyzed as per standard procedure.

The data on yield and quality parameters of pearl millet fodder is presented in table 1. The stage of harvest had a significant influence on the dry forage yield of both seed crop and ratoon crop. In seed crop, the crop harvested at flag leaf stage gave significantly lower quantity of dry forage (10.90 t ha^{-1}) when compared to the crops harvested either at flowering stage (13.82 t ha^{-1}) or at milk stage (14.65 t ha^{-1}). There was no significant difference in the dry forage yield of crops harvested at flowering stage or milk stage. The trend was exactly opposite in the ratoon crop. The ratoon obtained by harvesting the seed crop at flag leaf stage gave significantly higher dry forage yield (5.03 t ha^{-1}) as compared to the ratoon obtained by harvesting the seed crop at flowering stage or milk stage. These results were in conformity with the findings of Anderson and Matches (1983), Ushi and Hirota (1983). Leaf to stem index of seed crop declined rapidly from 60.15 per cent at flag leaf stage to 42.85 per cent at flowering stage, than it reached 38.50 per cent at milk stage which was significantly lower than at other two stages. In the ratoon crop, the leaf to stem index was significantly higher in the ratoon obtained by harvesting the seed crop at flowering stage (40.38%) compared to the ratoon obtained by harvesting the seed crop either at

flag leaf stage (36.67%)) or at milk stage (37.64%). There was a significant decrease in the crude protein content of seed crop due to the lateness in stage of harvesting of seed crop. Nitrogen uptake and protein synthesis, both of these processes are faster in the earlier part of the life cycle of any plant. In the later part of the life cycle protein will be utilized for the synthesis of carbohydrates, which in turn are utilized to meet the requirements of new tissues, so the protein content reduces. However, crude protein content of the ratoon crop did not vary significantly due to the variations in the harvesting of seed crop. These are in conformity with the findings of Bajpai *et at.* (1981). Terman and Allen (1971) concluded that nitrogen concentration usually decreases with increased dry matter yield as a result of dilution. In the present experiment dry forage yields of the ratoon cut and also the dry forage yields of seed crop at early stages (flag leaf stage) were much smaller. In addition ratoon crop took less number of days to flowering, it means growth rate was faster, due to this it could able to take up more nitrogen. Therefore, ratoon contained higher concentration of protein and this also due to higher concentration of leaves to the dry forage yield in the early stages, as leaves contain higher quantity of protein leaf to stem index was much higher in the crop harvested at flag leaf stage and it decreased rapidly thereafter.

Ash content of seed crop was highest in crop harvested at flowering stage (6.63) compared to crop harvested at flag leaf stage (6.03) and milk stage (5.62). Differences in the ash content were mainly due to the differences in the dry forage yield and crude protein content. The ash content of ratoon crop decreased significantly with the lateness in harvesting of seed crop. This difference was only due to the difference in the dry forage yields. Tiwana *et al*. (1983) and Desai and Washko (1982) found similar trend. Crude fiber content of forage increased significantly with lateness in stage of harvesting. Crude fiber content always increases with the maturity, because, structural components like cellulose, hemicellulose and lignin increase with maturity. Proportionate contribution of stem goes on increasing as the plant proceeds towards maturity. The results are in conformity with the finds of Gupta and Pradan (1975). Difference in the stage of harvest of seed crop had no influence on the crude fiber content of ratoon crop. The level of neutral detergent fiber in re growth of switch grass was also not affected by the delay in the harvest of the previous crop (Anderson and Matches, 1983).

The effect of nitrogen on the dry forage yield was significant in the seed crop. Increased nitrogen level (80 to 120 kg ha^{-1}) increased the dry forage yield from 12.44 to 13.81 t ha^{-1}. These results, Compared well with the findings of earlier workers (Munda *et al*., 1983 and Umrani *et al*., 1983). Numerical increase in the leaf to stem index of seed crop and ratoon crop due to the increased level of nitrogen to the seed crop were not significant. The crude protein content increased with increased nitrogen level in seed crop, whereas, crude protein content of the ratoon crop did not increase significantly with the increase in the nitrogen level to the seed crop. As nitrogen is a highly mobile nutrient in plant and also in soil, the residual affect will always be very small, similar was the report by Rai *et al*. (1981). Increased nitrogen level brought significant increase in the crude protein yield of seed crop. This was because of increased forage yield as well as crude protein content. However, there was no significant differences in the crude protein yield of ratoon crop due to the application of varied level of nitrogen to the seed crop, it is because there was no difference in crude protein content and also the dry forage yield of ratoon crop. These results compared well with the findings of Katoria *et al*. (1981).Increased level of nitrogen did not bring significant difference in the crude fiber content of both seed crop and ratoon crop. Earlier workers like Rao and Tomer (1974) also noticed similar results. But the increase in the dry forage yield of seed crop due to higher level of phosphorus fertilizer was not statistically significant, however,

Table 1 Quality and yield of forage pearl millet as influenced by N and P nutrient application and stage of harvesting

Treatments	Crude protein content (kg ha^{-1})		Ash content (%)		Crude fiber content (%)		Leaf to stem index		Yield (t ha^{-1})	
	Seed crop	Ratoon crop	Seed crop	Ratoon crop	Seed crop	Ratoon crop	Seed crop	Ratoon crop	Seed crop	Ratoon crop
Stage of Harvesting										
Stage-I	10.17	9.83	6.63	6.19	21.99	27.57	60.15	36.67	10.90	5.03
Stage-II	8.81	9.62	6.27	6.03	25.98	28.03	42.85	40.38	13.83	4.04
Stage-III	6.39	9.74	5.62	5.99	29.36	27.49	38.50	37.64	14.66	3.62
SEm±	0.14	0.18	0.09	0.09	0.31	0.54	1.22	0.76	0.31	0.10
CD at 5 %	0.40	NS	0.26	NS	0.90	NS	3.58	2.22	0.91	0.29
Nitrogen levels										
N80	7.97	9.69	6.14	6.05	25.89	27.62	45.51	38.22	12.44	4.27
N120	8.95	9.76	6.21	6.09	25.64	27.78	46.83	38.24	13.81	4.19
SEm	0.11	0.15	0.07	0.07	0.25	0.44	0.99	0.62	0.25	0.08
CD at 5 %	0.33	NS	NS	NS	NS	NS	NS	NS	0.75	NS
Phosphorus levels										
P_{40}	8.46	9.75	6.07	6.12	25.50	27.48	45.66	38.11	12.99	4.11
P_{60}	8.46	9.71	6.28	6.02	26.03	27.91	46.68	38.34	13.26	4.35
SEm	0.11	0.15	0.07	0.07	0.25	0.44	0.99	0.62	0.25	0.08
CD at 5 %	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.23

Note: Interaction effect were found Non-significant NS- Non-significant

increased level of phosphorus increased the dry forage yield of ratoon crop. The increase in the dry forage yield of ratoon crop was from 4.11 to 4.35 t ha^{-1}. Similar increase in the ratoon yields has been reported by Yamasaki and Ujike (1983). The numerical increase in the leaf to stem index of seed crop and ratoon crop due to the increased level of phosphorus to the seed crop were not significant. Increasing the phosphorus level did not cause any significant difference in the crude protein content and ash content of both seed crop and ratoon crop. Similarly crude protein yield of seed crop differed non-significantly due to phosphorus levels, the effect of phosphorus on the crude fiber content of forage was also similar to that of nitrogen. Tripathi et al (1979) also did not notice any significant difference in the neutral detergent fiber content of forage oats due to the variation of phosphorus levels. The effect of interaction between stage of harvesting and nitrogen levels on quality and dry forage yield were non-significant.

Hence, it may be concluded that inorder to obtain higher forage yield, better quality character and better ratoonability of pearl millet fodder with harvesting at flowering stage and application of 120 kg nitrogen and 60 kg phosphorus per ha.

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