



Identification of optimum stage of harvesting for seed yield and seed quality parameters of forage grasses

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ABSTRACT

A field experiment was conducted at Indian Grassland and Fodder Research Institute, Southern Regional Research Station, Dharwad during *kharif* 2016 and laboratory studies in 2017 to identify the harvesting stages on seed yield and quality in guinea and brachiaria grasses. The experiment was laid out in simple RCBD with eight treatments replicated thrice. The results of the investigation revealed that treatment T8, i.e. seeds collected at 20 days after panicle emergence (DAPE) produced maximum number of panicles and number of racemes/panicle in guinea and brachiaria grasses, respectively. On the contrary, number of seeds/panicle were highest in treatment T1 (seeds harvested at 6 DAPE) in guinea grass and in treatment T6 in brachiaria grass. Likewise, the fresh weight of the seeds/panicle was highest in T1 in guinea grass and in T6 in brachiaria grass. Whereas, the treatment T5 (seeds harvested at 14 DAPE) in case of guinea grass and T6 (seeds harvested at 16 DAPE) in case of brachiaria produced maximum seed yield/panicle and ha, respectively. The treatment T8 recorded the highest germination percentage in guinea and brachiaria grasses, respectively. The same treatment also recorded the lowest dead seed per cent. The lowest seed germination (%) was recorded in T1 in both the crops. On the contrary, highest fresh un-germinated seeds was recorded in case of guinea grass seeds in T3 and in case of brachiaria seeds in T8. Higher vigour index was recorded in T8 (seeds harvested at 20 DAPE) in both the crops. Guinea grass can be harvested at 16 DAPE and brachiaria grass can be harvested at 18 DAPE to get maximum quantity of high quality seeds.

Key words: Brachiaria grass, Germination, Guinea grass, Panicles, Seed yield, Vigour

Guinea grass is a popular fodder grass of the tropics suited well to the 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 due to its ability to tolerate the shade. As an excellent fodder, it is much valued for its high productivity, palatability and good persistence. Brachiaria grass is largely cultivated as a pasture crop in southern parts of the country due to its high fodder potential. This genus comprises of several species which have varying degrees of adaptation to environmental conditions. Among them *B. ruziziensis*, *B. decumbens*, *B. brizantha* and *B. humidicola* are largely grown in India for fodder purpose.

Many of the tropical indigenous grass species are relatively wild which have not been domesticated and rigorously selected for good seed production characteristics because of which many problems have been encountered in the seed multiplication tasks in these species. The major problem is that seeds in the grass species do not mature at one time; hence it is difficult to judge the rate of increase

of ripe seeds from new inflorescences just to balance the loss of high quality seed from older inflorescences (Berdahl and Frank 1998). Moisture content falls quite rapidly after full development of seed, which affects the overall viability of harvested seeds. Another problem that confronts grass seed growers is the readiness of most tropical pasture seed to abscissa or to detach themselves shortly after reaching maturity. This prevents the amassing on the crop of the successfully ripened seeds.

It is known fact that as grass species have been evolved as perennials for vegetative forage yield, they have very low seed productivity (Chatterjee and Das 1989). As such, the productivity and availability of seeds in the inflorescence *per se* at harvest have been observed to be important factors in the seed production of any grass species. The proportions of mature and immature seeds in a seed lot define the quality of seeds in these grasses. In this context, a field experiment was to identify the optimum stage of maturity (harvesting time) on seed yield and seed quality in guinea (*Panicum maximum*) and brachiaria (*Brachiaria ruziziensis*) grasses.

MATERIALS AND METHODS

A field experiment was carried out at the Indian Grassland and Fodder Research Institute, Southern Regional Research Station, Dharwad during *kharif* 2016 and laboratory

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studies were done in 2017 to identify the optimum stage of maturity (harvesting time) on seed yield and seed quality in guinea cv. DGG-1 and brachiaria cv. DBRS-1 grasses. Dharwad is situated in Northern Transitional Zone (8) of Karnataka at 15°-54 ' N latitude and 74°-8' East longitude at an altitude of 686 m above mean sea level.

The experiment was laid out in Randomized Complete Block Design (CRBD) with eight treatments, viz. T₁ Harvesting of seeds 06 days after panicle emergence, T₂ Harvesting of seeds 08 days after panicle emergence, T₃ Harvesting of seeds 10 days after panicle emergence, T₄ Harvesting of seeds 12 days after panicle emergence, T₅ Harvesting of seeds 14 days after panicle emergence, T₆ Harvesting of seeds 16 days after panicle emergence, T₇ Harvesting of seeds 18 days after panicle emergence and T₈ Harvesting of seeds 20 days after panicle emergence and replicated thrice. Firstly the seedlings were raised in nursery bed and 30 days old seedlings were transplanted to main field in individual plots of 4.6 m × 4.2 m size. In each plot of both the crops, emergence of panicle was taken as a base for the identification of physiological maturity. Twenty five panicles were tagged randomly on the day of emergence to identify the right harvesting stage. The tagged panicles (10 no's) were harvested from 6 day after emergence at every alternate day till the 20th day. These harvested panicles were used for recording observations on growth, yield and seed quality parameters.

Following characters, viz. panicles/plant, number of racemes/plant, number of seeds/panicle, fresh weight of seeds (g), seed yield/panicle (g) and kg/ha, seed germination (%), fresh un-germinated seeds (%), dead seeds (%) and seedling vigour index (%) were studied. All data recorded were analyzed with the help of analysis of variance (ANOVA) (Gomez and Gomez 1984). The least significant difference test was used to separate main and interaction effects of treatments at 5 % level of significance.

RESULTS AND DISCUSSION

Number of panicles/plant due to harvesting stages was highly significant in both the grasses. The treatment T₈ having seeds collected at 20 days after panicle emergence (DAPE) recorded highest panicles (24 and 51) in guinea and brachiaria grasses, respectively. Whereas, highest number of racemes/panicle (96 and 3.4) was recorded in T₇ (18 DAPE) in case of guinea grass and T₈ (20 DAPE) in case of brachiaria grass, respectively (Table 1 and 2). The higher number of racemes/panicle was recorded in T₇ (18 DAPE) in case of guinea grass and T₈ (20 DAPE) in case of brachiaria grass was on par with T₅ (94) in guinea grass, T₃ (3.4) and T₆ (3.4) in brachiaria grass but significantly superior over other treatments. The lowest number of racemes/panicle (77 and 3.0) were recorded in T₂ and T₁ in guinea and brachiaria grasses, respectively. The results clearly indicated that the number of panicles and racemes/panicle increased as harvesting period progresses. However, the rate of increase in growth and development of number of panicles and racemes ceased from 16 day after panicle emergence in both the grasses. It might be due to increased translocation of metabolites from source to sink upto physiological maturity, i.e. till 16 DAPE. These findings are in agreement with the work of Hare *et al.* (1999), who reported that cutting seed crops of *Paspalum atratum* in August and September in Thailand produced little or no seed. Cutting in July produced the best seed yield over rest of the cutting dates.

Number of seeds/panicle (5717) was the highest in T₁ (6 DAPE) in guinea grass and in T₆ (16 DAPE) in case of brachiaria grass (180) and were significantly superior over other treatments. Whereas, T₈ recorded the lowest (2368 and 133.22) number of seeds/panicle in case of guinea and brachiaria grasses, respectively (Table 1 and 2). Similarly, fresh weight of seeds/panicle harvested at T₁ (6 DAPE) showed the highest value (10.60 g) in guinea grass and in

Table 1 Influence of harvesting stages on growth, yield and seed quality parameters in guinea grass

Seeds harvested days after panicle emergence (DAPE)	No. of panicles/plant	No. of racemes/panicle	Number of seeds/panicle	Fresh weight of seeds/panicle (g)	Seed yield/panicle (g)	Seed yield (kg/ha)	Seed germination (%)	FUG seeds (%)	Dead seeds (%)	Seedling dry weight (mg)
T1- 06 DAPE	12	79	5717	11	2.97	83	8.2 (17)*	66 (54)	27 (31)	14.2
T2- 08 DAPE	18	77	5521	8.3	2.75	86	8.5 (17)	67 (55)	24 (30)	14.8
T3- 10 DAPE	19	82	5319	7.2	2.69	88	11 (19)	67 (55)	22 (28)	15.6
T4- 12 DAPE	22	90	5036	5.2	2.99	93	15 (22)	66 (54)	20 (26)	17.1
T5- 14 DAPE	22	95	4569	5.1	3.48	104	17 (24)	66 (54)	17 (24)	17.2
T6- 16 DAPE	23	94	3476	4.8	2.65	99	22 (28)	63 (52)	15 (23)	17.4
T7- 18 DAPE	23	96	2706	3.9	2.13	97	24 (29)	63 (52)	13 (21)	17.5
T8- 20 DAPE	23	94	2368	3.5	1.91	94	29 (32)	60 (51)	12 (20)	17.2
Mean	20	89	4339	6.1	2.69	93	17 (24)	65 (54)	19 (26)	16.4
SEm±	0.53	3.22	271.4	0.28	0.11	1.84	0.64	0.99	0.50	0.44
CD (P=0.05)	1.61	9.76	823.3	0.86	0.35	5.58	1.95	3.01	1.51	1.32

*Figures in the parentheses indicate arcsine root transformed values.

Table 2 Influence of harvesting stages on growth, yield and seed quality parameters in brachiaria grass

Seeds harvested days after panicle emergence (DAPE)	No. of panicles/ plant	No. of racemes/ panicle	Number of seeds / panicle	Fresh weight of seeds / panicle (g)	Seed yield /panicle (g)	Seed yield (kg/ha)	Seed germination (%)	FUG seeds (%)	Dead seeds (%)	Seedling dry weight (mg)
T1- 06 DAPE	36	3.1	161	0.53	0.38	116	4.4 (12.1)*	62 (52)	34 (35)	32
T2- 08 DAPE	39	3.2	169	0.59	0.41	125	4.6 (12.3)	68 (55)	28 (32)	34
T3- 10 DAPE	43	3.4	172	0.65	0.46	129	5.1 (13.0)	68 (56)	27 (31)	36
T4- 12 DAPE	46	3.3	177	0.67	0.49	129	7.4 (15.7)	67 (55)	26 (30)	37
T5- 14 DAPE	48	3.3	178	0.68	0.49	133	8.3 (16.7)	68 (55)	24 (29)	39
T6- 16 DAPE	50	3.4	180	0.70	0.53	139	10.7 (19.1)	70 (57)	19 (26)	39
T7- 18 DAPE	51	3.2	151	0.67	0.51	136	10.9 (19.3)	71 (57)	18 (25)	39
T8- 20 DAPE	51	3.4	133	0.62	0.48	135	12.0 (20.3)	72 (58)	16 (23)	40
Mean	46	3.3	165	0.64	0.47	130	7.9 (16.3)	68 (56)	24 (29)	37
SEm±	1.34	0.19	5.10	0.03	0.024	3.79	0.51	1.45	1.21	0.70
CD at 5 %	4.06	0.57	15.46	0.09	0.074	11.50	1.55	4.48	3.67	2.13

*Figures in the parentheses indicate arcsine root transformed values

treatment T₆ (16 DAPE) in case of brachiaria grass (0.70 g). The seeds harvested at 20 days after panicle emergence (T₈) recorded the lowest (3.47 g) value of fresh weight of

seeds/panicle in guinea grass and treatment T₁ recorded the lowest (0.53 g) value in case of brachiaria grass.

Both number of seeds and fresh weight of seeds/panicle

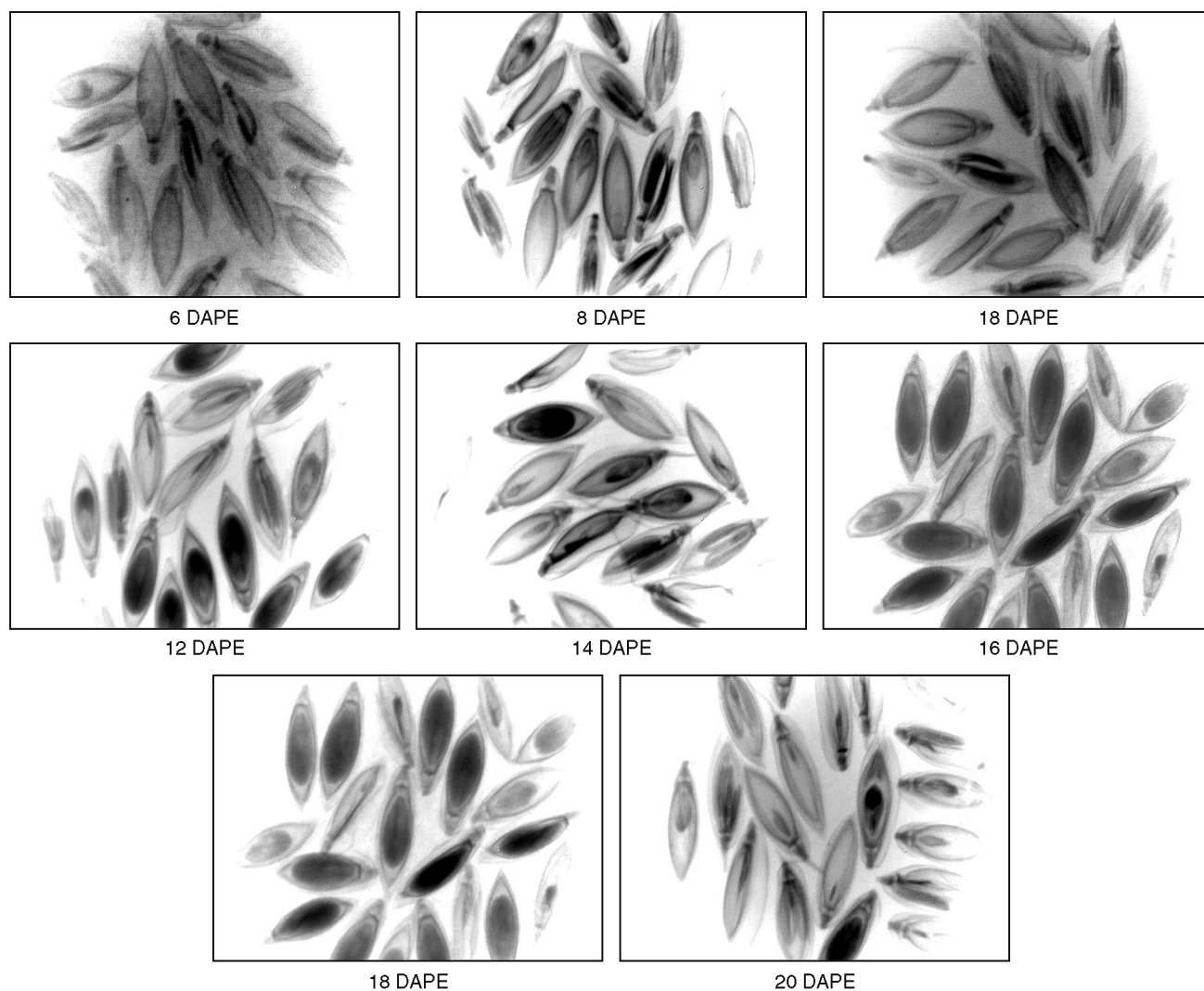


Fig 1 Soft X-ray radiography results in guinea seeds.

showed decreasing trend till the harvesting period ends in case of guinea grass, whereas in brachiaria grass it showed increasing trend till 16 DAPE, then it started declining. This clearly indicates that the seed shattering in case of guinea grass began at 6 DAPE itself. It might be due to the seeds are very light in weight and are loosely held to racemes, because of this seed shedding takes place. Substantial loss in seed number due to harvesting stages in guinea grass might also be due to translocation of assimilates to the seed which was evidenced by rapid loss in seed moisture at later stages of crop growth. Whereas, in case of brachiaria, number of panicles and fresh weight of seeds/panicle showed increasing trend till 16 DAPE indicating that seeds are comparatively tightly held and bold in nature. These findings are in corroboration with the results of Pizarro *et al.* (2010). They have conducted an experiment on effect of harvesting methods on seed yield and quality of brachiaria hybrid Mulato-II with five harvesting methods, viz. seeds knocked into large cloth bags daily, twice daily, on alternate day, inflorescences enclosed in mesh bag and ground sweeping. The results revealed that highest seed

yield and 1000 seed weight were recorded in nylon net bag treatment. The lowest seed yield and 1000 seed weight was recorded in ground sweeping method of harvest.

In the present investigation the data on seed yield/panicle and seed yield/ha showed significant results (Table 1 and 2). The treatment T_5 (14 DAPE) in case of guinea grass and T_6 (16 DAPE) in case of brachiaria produced maximum (3.5 g and 0.53 g; 104 kg and 139 kg, respectively) seed yield/panicle and ha. The seed yield increased till 14 DAPE in guinea and 16 DAPE in brachiaria grass and reduction in yield was observed in later stages of harvesting. The rapid translocation of metabolites in the developing seeds up to 14 DAPE in guinea and 16 DAPE in brachiaria resulted in well filled seeds which were reflected in higher seed yield/panicle. This indicated that the seeds have reached maturity at respective stages for harvesting. These results are in conformity with the reports of Sureshababu *et al.* (2003) in brinjal. In the present investigation total seed yield decreased slightly after maturity. This might be due to accumulated effect of seed yield/panicle and its test weight.

Seed quality parameters: The initiation of laboratory

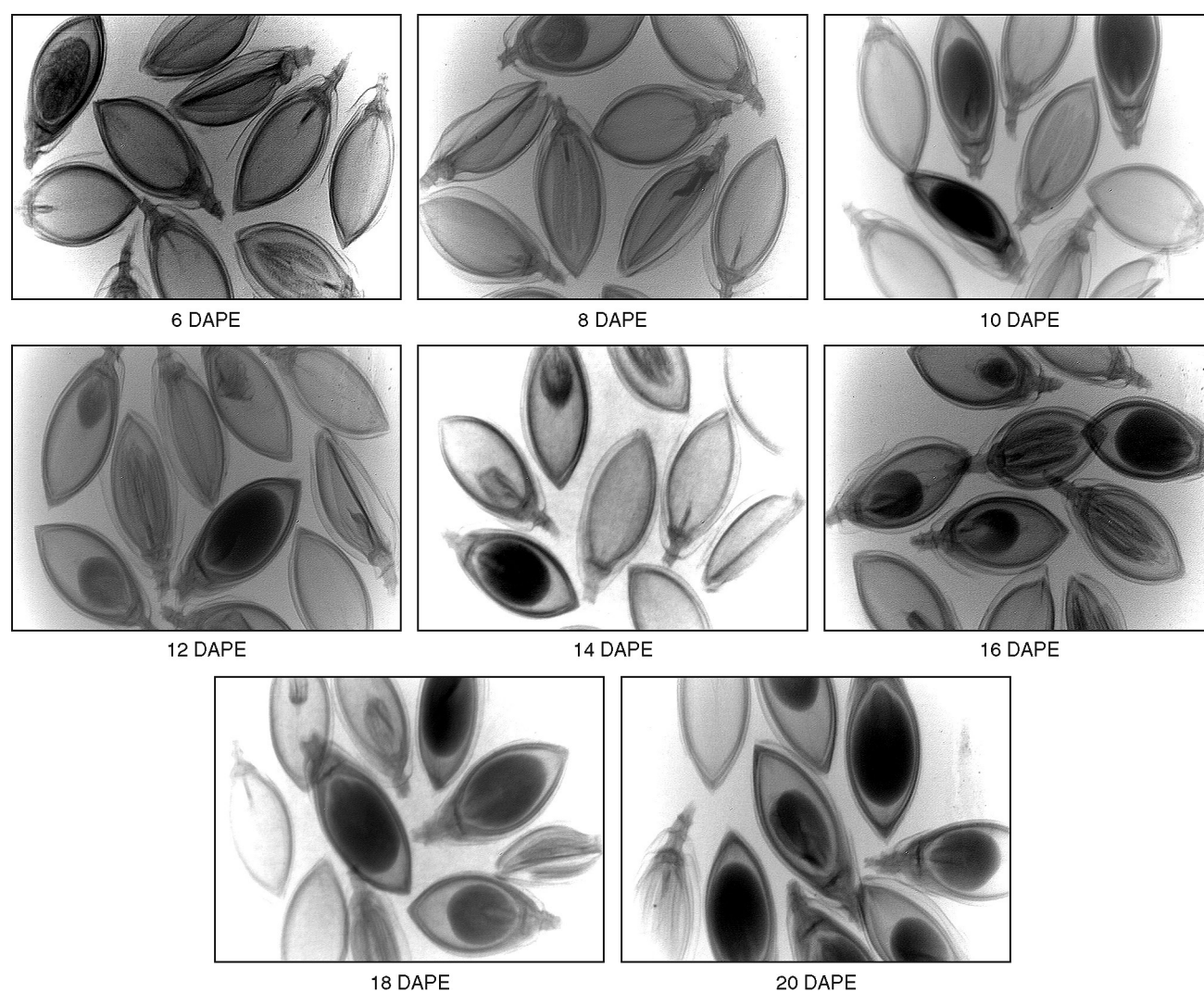


Fig 2 Soft X-ray radiography results in brachiaria seeds.

germination was noticed in seeds collected at 6 DAPE itself. The progressive increase in germination was observed up to 20 DAPE in both the grasses studied. On the contrary, the fresh non-germinated seed components in seed lot harvested at 20 days after panicle emergence (T_8) recorded the lowest (60.21 %), whereas in case of brachiaria grass the lowest (62.0 %) was in T_1 . Similarly, the treatment T_8 also recorded the lowest (12.28 and 15.80 %, respectively) dead seed percentage in guinea and brachiaria grasses (Table 1 and 2). It is *vice versa* for the seeds harvested at the initial period of anthesis (Fig 1 and 2). The decrease in laboratory germination from early harvested seeds might be due to more number of immature seeds and high maintenance of respiration. These results are in conformity with Radheshyam *et al.* (1996) who reported that chilli seeds with high germination and vigour can be obtained from seeds collected at 48 days after anthesis. 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 are also responsible for effective conversion of macromolecules into micro molecules within the seed during seed germination. 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. Kiyothong *et al.* (2002) revealed that seed yield and seed quality were significantly higher when cut at 90 days after sowing, than cutting at 75 and 65 days after sowing. There were no significant differences between cutting at 60 and 75 days in 1000 seed weight, but both the treatments were higher than cutting at 90 days and uncut in *Stylosanthes guianensis*.

Seedling vigour index was influenced significantly by harvesting stages (Table 1 and 2). Among the treatments, it was highest (415.1 and 180.1 respectively) in T_8 (seeds harvested at 20 DAPE) in both the grasses and they were significantly superior over other treatments. At physiological maturity, seeds are said to be completely developed due to maximum accumulation of food reserves, amino acid, phosphorous active substances, dry matter, sugar, water soluble proteins, acids and nicotinic acid levels in the seeds Dhanellappagol *et al.* (1994). On the contrary, all seed quality parameters were low in early harvested tomato seeds due to presence of large number of immature and under developed seeds with lesser food reserves and nutrients in the seeds (Hare *et al.* 2015). From the results of present study, it can be stated that guinea grass crop can be harvested at 16 DAPE and brachiaria grass crop

can be harvested at 18 DAPE and may be considered as physiologically matured.

The results obtained from this experiment clearly suggest that harvesting stage has significant effect on seed yield and quality in both the grasses. Timing of harvest is very important, delay in harvesting results in shedding of seeds and early harvesting contributes to more number of immature seeds in a seed lot. Therefore, it can be concluded from the experimental results that guinea grass can be harvested at 16 DAPE and brachiaria grass can be harvested at 18 DAPE to get maximum amount of high quality seeds.

REFERENCES

- Berdahl J D and Frank A D. 1998. Seed maturity in four cool-season forage grasses. *Agronomy Journal* **90**: 483-8.
- Chatterjee B N and Das P K. 1989. *Forage crop production: Principles and practices*. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi, India
- Dhanellappagol M S, Shashidhara S D and Kulkarni G N. 1994. Effect of stages of harvesting and methods of drying of chilli fruits on seed quality. *Karnataka Journal of Agricultural Sciences* **7**: 36-9.
- Gomez T L and Gomez T M. 1984. *Statistical Analysis for Research Experiments*, pp. 228-36. Oxford and IBH Publ. Com, New York.
- Hare M D, Wongpichet K, Tatsapong P, Narksombat S and Saengkhum M. 1999. Method of seed harvest, closing date and height of closing cut affect seed yield and seed yield components in *Paspalum atratum* in Thailand. *Tropical Grasslands* **33**: 82-90.
- Hare M, Pizzaro E A, Supaphan P, Theerachai S and Naddakorn S. 2015. Evaluation of new hybrid brachiaria lines in Thailand. 2. Seed production. *Tropical Grasslands* **3**: 94-103.
- Kiyothong K, Satjipanon C and Pholsen P. 2002. Effect of cutting height and time on seed yield and seed quality of *Stylosanthes guianensis* CIAT 184. *Songklanakarin Journal of Science and Technology* **24**: 587- 93.
- Pizarro E A, Hare M, Antezana Rojas J H, Ramón R R, Miranda I G, Chávez C A, Balbuena A and Miles J W. 2010. April. Harvest methods and seed yield potential in Brachiaria hybrids. (In) *Proceedings of the Seventh International Herbage Seed Conference*. G R Smith, G W Evers & L R Nelson (eds). Dallas, Texas USA, pp 11-3.
- Radheyshyam, Arora S K, Pandita M L and Jagdeep Singh. 1996. Effect of stage of fruit maturity at harvest on seed quality of chilli cultivar. *Haryana University Journal of Research* **26**: 195-8.
- Sureshbabu T, Kurdikeri M B, Shekhargouda M, Shashidhara S D and Dharmatti P R. 2003. Influence of fruit maturity stages and post harvest ripening on seed yield and quality in brinjal. *Seed Research* **31**: 204-8.