

Quality seed production of range grasses – A major constraint in revitalizing tropical pastures

D.R. MALAVIYA, D. VIJAY, C.K. GUPTA, A.K. ROY AND P. KAUSHAL

Indian Grassland & Fodder Research Institute, Jhansi, U.P., India. www.igfri.res.in

Keywords: Seed setting, seed germination, hormonal solutions.

Introduction

Only 4% of India's geographical area of 326.82 Mha is under pastures. Socioeconomic and ecological consequences of land degradation are affecting 85 Mha of rangelands/grasslands. To provide sufficient milk for the ever-growing population, current milk production of 128 Mt must increase to 160 Mt by 2020. To make this possible, an additional 825 Mt of green fodder is required. Increasing the area producing green fodder is difficult because of severe competition from food crops. Revitalizing the denuded grasslands is the most plausible means for improving the availability of green fodder. This needs mission mode programs with participation of the people.

One impediment to increased green fodder production is limited availability of good quality seed. In India only 25–30% of the required seed is available for sowing cultivated fodder and 20% and 15% for range grasses and legumes, respectively (Anon. 2011). Forage seed production encounters several problems, namely: poor seed setting; extreme climatic conditions; seed shattering and non-synchronization in maturity; and the presence of empty seeds. Empty seeds with partially developed embryos and poor nutrient reserves fail to germinate. The standard germination percentage of most tropical grasses is around 20–30 percent. Several studies have been conducted to enhance germination by treating with GA₃ or KNO₃ or by other means of dormancy removal. However, the major reason for the low germination percentage is formation of 'false' seeds (dry floral parts without fully developed seeds). Wobus and Weber (1999) emphasized the role of hormones in combination with other seed metabolites, including sugar, in seed maturation. Understanding reproductive biology and harvest scheduling are also important for enhancing formation of pure, germinating seeds. Hence, the present study was con-

ducted to understand seed setting and the effects of external hormonal application on seed germination.

Methods

Seed-setting studies

To study seed setting, the annual range grass, *Pennisetum pedicellatum*, commonly known as *Dinanath* grass in India, was chosen. The seed harvested in bulk was examined for the presence of caryopses in the spikelets by manual defluffing. Separately, 10 individual inflorescences of *P. pedicellatum* var. *Bundel Dinanath-1* and *Bundel Dinanath-2* were taken and caryopses from each spikelet were separated manually by slightly pressing at the bottom. The presence or absence of caryopses in spikelets was noted for further calculation. The seed setting percentage was calculated by counting the total number of spikelets per panicle and spikelets carrying a true caryopsis.

Hormonal studies on seed germination

The effects of hormones on seed germination were studied by spraying 25, 50 and 100 ppm IAA (indoleacetic acid) on Guinea grass (*Panicum maximum* var. BG-2) inflorescences in the field. The IAA solutions were prepared and 0.05% tween-80 was added to enhance adsorption of the solutions. Ten inflorescences were selected and the spray was applied twice at 4-day intervals. The individual treated inflorescences were collected along with controls at maturity and the seed was bulked for further germination studies, with 3 replications, using the standard procedure in sand. Germination was recorded till no further increase in the number of seedlings was observed.

Seed-ripening studies

The effects of hormonal solutions on seed ripening were studied by dipping the cut panicles of *Panicum maximum* in hormonal solutions and water. Five guinea grass panicles were collected at the anthesis stage from the field. The panicles were dipped in 100 ppm and 200 ppm solutions of IAA, kinetin and water. A control without water was also studied. Matured seeds from each treat-

Correspondence: D.R. Malaviya, Indian Grassland & Fodder Research Institute, Jhansi - 284003, U.P., India.
Email: drmalaviya47@rediffmail.com

ment were collected separately. The experiment was conducted under ambient room temperature with 3 replications.

Results and Discussion

The 2 released *Dinanath* grass varieties BD-1 and BD-2 were distinctly marked for single floret and 3 florets per sessile spikelet, respectively. The percentage of well-developed seeds per panicle was found to be 96% and 92% in BD-1 and BD-2, respectively, whereas in normal bulk-harvested seed lots, only 20–60% of spikelets contain filled seeds. The naked seeds, i.e., caryopses, obtained showed 93% germination. Thus, formation of pure germinating seed (caryopses) in *Dinanath* was found to be >90%. Observations revealed that a lot of caryopses were dropped during harvesting in bulk harvests due to the species' floral structure. Thus, harvesting at physiological maturity is crucial to optimize re-

covery of spikelets with caryopses. In this context, the development of physiological and harvesting maturity indices for bulk harvesting of *Dinanath* grass should be given high priority in research programs.

External application of IAA at 25, 50 and 100 ppm at the panicle emergence stage in *Panicum maximum* (var. BG-2) substantially increased germination, with the highest germination (45%) being obtained at 100 ppm IAA (Table 1). Rate of germination in IAA treatments was also higher than in the control. These results might be due to an increased number of pure germinating seeds or an increase in germination per se. Barazesh and McSteen (2008) showed that hormones play an important role in inflorescence development in grasses. A positive response of guinea grass to auxin (IAA) paves the way for further exploration of phytohormone-induced seed development in range grasses.

Table 1. Effects of indoleacetic acid (IAA) treatment of Guinea grass panicles on seed germination.

Treatments	Germination (%)		
	Day 4	Day 6	Day 8
Control	15.3	23.3	26.0
IAA 25 ppm	19.3	33.3	34.7
IAA 50 ppm	20.0	34.0	38.7
IAA 100 ppm	23.3	40.7	44.7

The cut panicles of *Panicum maximum* showed varying degrees of liveliness after treatment with different solutions. Cut panicles without water dried early, followed by those dipped in kinetin and water, with panicles dipped in IAA solution remaining viable for longest. In *P. maximum* under field conditions, spikelets shattered within a week after anthesis. If liveliness can be maintained in cut panicles, the shattering loss can be minimized and more mature seed can be collected than with bulk harvest.

Conclusions

Seed setting as such is not a problem in the annual range grass *Pennisetum pedicellatum* but shattering of caryopses during bulk harvest leads to a low germination percentage in harvested seed. Physiological and harvesting maturity indices must be developed to retain caryopses

in the harvested spikelets. External application of phytohormone IAA at 100 ppm during anthesis could be one strategy for increasing subsequent seed germination. Additionally, in order to decrease harvesting costs in grasses with non-synchronous maturity, increased liveliness following IAA treatment could be a mechanism for optimizing yield of high quality seed by allowing more time for seed maturity after harvest.

References

- Anonymous. 2011. IGFR vision 2030. Indian Grassland and Fodder Research Institute, Jhansi, U.P., India.
- Barazesh S; McSteen P. 2008. Hormonal control of grass inflorescence development. *Trends in Plant Science* 13:656–662.
- Wobus U; Weber H. 1999. Seed maturation: genetic programmes and control signals. *Current Opinions in Plant Biology* 2:33–38.



Malaviya DR; Vijay D; Gupta CK; Roy AK; Kaushal P. 2013. Quality seed production of range grasses – A major constraint in revitalizing tropical pastures. *Tropical Grasslands – Forrajes Tropicales* 1:97–98.
DOI: [10.17138/TGFT\(1\)97-98](https://doi.org/10.17138/TGFT(1)97-98)

This paper was presented at the 22nd International Grassland Congress, Sydney, Australia, 15–19 September 2013. Its publication in *Tropical Grasslands – Forrajes Tropicales* is the result of a co-publication agreement with the IGC 2013 Organizing Committee. Except for adjustments to the journal's style and format, the text is essentially the same as that published in: **Michalk LD; Millar GD; Badgery WB; Broadfoot KM, eds. 2013. Revitalising Grasslands to Sustain our Communities. Proceedings of the 22nd International Grassland Congress, Sydney, Australia, 2013. New South Wales Department of Primary Industries, Orange, NSW, Australia. p. 203–204.**