Sciencia Acta Xaveriana
An International Science Journal
ISSN. 0976-1152

Volume 7
No. 1
pp. 1-8
March 2016

STUDIES ON PHENOLOGY AND POSITIONAL POLYMORPHISM ON SEED QUALITY OF GRAIN AMARANTHUS CV. SUVARNA

S. MANIKANDAN[1]* AND P. SRIMATHI [2]

[1*]Department of Seed Science and Technology, Tamil Nadu Agricultural University,

Coimbatore – 641 003, Tamil Nadu, India

[2]Seed Centre, Tamil Nadu Agricultural University, Coimbatore – 641 003, Tamil Nadu, India.

*E-mail: vsmanister@gmail.com

ABSTRACT

The studies on phenology and positional polymorphism on seed quality of grain amaranthus were evaluated in the field and laboratory studies were conducted at Tamil Nadu Agricultural University, Coimbatore. The study revealed that the fruiting and flowering period extended for 3 and 10 days respectively while the spike maturation occur 26 to 30 days after completion of flowering and the total duration of the crop from sowing to harvest was 83 - 87 days and seeds of middle portion of spike recorded higher values for seed and seedling quality characters and was found to be better than the seeds extracted from bottom or top portion of spike and also from the whole spike.

Key Words Grain amaranthus, seed, phenology, positional polymorphism, seed quality

(Received : 1st December 2014 ; Accepted : 3rd March 2015)

INTRODUCTION

Grain amaranth seed has high protein concentration and a very favourable amino acid composition (high lysine concentration) and is used to upgrade the quality of foodstuffs (Sounders and Becker, 1983). Grain amaranth is the cheap, highly nutritive and most popular leafy vegetable is being propagated through seeds. The use of good quality seed is indispensable for the successful production of any crop. Polymorphism is the occurrence of different forms of individuals in single species or the presence of distinct forms in a species particularly with certain habitat or population. Phenology is the art of studying the flowering behaviour of crop plants. The phenophase of plant life cycle varies with genotype and the

environment prevailed at place of production. Studies on phenology are necessary in all agricultural, horticultural and sylvicultural crops for effective practicing of management techniques for better yield and to obtain the quality produce (Mukerjee, 2004). Physical polymorphism is common occurrence in seed, which occur due to the flowering behaviour (reflected on seed formation and maturation), plant senescence or places of seed formation on the mother plant. The latter one is known as positional polymorphism and influences the morphological and physiological characters of seeds Kalavathi, (1997) in green manures and medicinal plants respectively observed such positional polymorphism and correlated its influence with seed quality characters. Knowledge on this is warranted for selection of source seed for breeder or nucleus classes and at times for foundation seed, which are precious and are to be maintained at higher quality for future multiplication. Hence, present study; seeds were evaluated for their influence at field and laboratory investigation to identify phenology and effect of positional polymorphism on seed quality parameters of grain amaranthus.

MATERIALS AND METHOD

Studies on phenology

In a bulk crop, fifty plants were tagged as 5 x 10 replications. In each of the plant, the phenological observations were made viz., days for initiation of spike, days for 50 per cent spike formation, days for completion of spike formation, pattern of flowering, days for initiation of flowering within a spike, days for 50 per cent flowering within a spike, days for completion of flowering within a spike, number of spike plant, number of spikelet spike and days for maturation.

Positional polymorphism on seed quality

The spikes harvested in bulk were sorted out in to uniform size, based on length and breath and separated into three different positions as top, middle and bottom based on the length (1/3 portion each). The seeds were extracted from each of the position separately and observed for the following seed quality characters immediately and each separated seeds were subjected to storage by cloth bag and after six months of storage the seed quality were observed.

Seed recovery (%)

The seed recovery from the spike was calculated adopting the following formula

$$\text{Seed recovery (\%)} = \frac{\text{Seed weight}}{\text{Spike weight}} \times 100$$

Graded seed recovery (%)

The seeds were size graded using BSS 22 x 22, square wire mesh sieve and the seeds retained on the sieve were weighed and expressed as percentage of total quantity of seeds processed. From the cleaned seeds and the following quality evaluations were carried out.

Seed and seedling quality evaluation

The seeds obtained through all grading techniques were evaluated for the seed physiological, biochemical and seedling quality characters *viz.,* 100 seed weight, seed germination, seedling length and drymatter production were observed as per ISTA (1999) and vigour index values were computed as per Abdul baki and Anderson (1973) adopting the following formula as it is the totality of seed quality characters. Vigour index = Germination (%) x Total seedling length (cm).

RESULTS AND DISCUSSION

Phenology

The phenological studies conducted with grain amaranth, the annual crop under Coimbatore conditions (11°02'N; 76°57E; 426 M above sea level) revealed that 40 days after sowing the spike formation had initiated and it attained fifty per cent just two days after initiation (42 days) while the completion was just one day later at 43 days after sowing indicating that the formation of spike would complete within three days of initiation (Figure 1). Within each spike, the flowering initiates from bottom and moves up to top expressing the basipetal type of flowering. Four days after completion of spike formation, i.e. on 47 days after sowing, flowering was initiated which reached 50 per cent flowering on 53 days and completion within 57days after sowing (Table 1). The number of spikes formed in each of the plant varies from one to two but 97 per cent of the population had mono spike and in each of the spike the number of spikelets vary from 50 to 65. The spike attained maturation 83- 87 days after sowing. Similar variation with the formation, flowering and maturation with varieties and locations were reported by the botanists (Mukerjee, 2004).

Positional polymorphism

The study expressed that in general, the seeds collected from middle portion of spike recorded higher seed and seedling quality characters and was followed by seeds of middle and bottom portion of the spike. Among the observed characters, seed recovery was 6 and 20 per cent higher in middle position of spike than bottom and top position of the spike respectively (Figure 2). Similarly, the seed recovery per cent was more in middle portion of the spike than bottom and top position by

12 and 45 per cent (Table 2). The 100 seed weight was also higher in middle spike than the bottom and top position. Menaka (2000) revealed that in amaranthus seeds of middle position possessed higher seed quality in terms of germination 95 per cent and vigour while the seeds with lower quality were obtained from top and bottom positions of the inflorescence. In the present study also the germination 98 per cent and vigour characteristics were higher with seeds of middle spike than the top and bottom portions of the spike which was 5 per cent and 2 per cent respectively; with the seed germination recorded with whole spike recorded 93 per cent. In accordance with Srimathi and Ramasamy (1992) on analyzing the variation in seed characters of cowpea due to pod position expressed that the reduced size and weight of the seeds in both proximal and distal ends in a pod could be ascribed to time lag between fertilization and consequent changes in the supply of nutrients and such variations were also observed due to translocation of food material within the pods of crown by Srimathi *et al.* (1991) in acacia.

Evaluated physiological seed characters after 6 months of storage also retained variation exhibited with fresh seeds due to their positional variation, in which the germination recorded was higher in middle position of spike by 2 and 4 per cent increased, compared to bottom and top positions of the spike respectively (Table 3). The seedling vigour parameters evaluated were also in line with said seed characteristics due to the relation between the source to sink as detailed elsewhere. Such differences in quality, in relation to position of the seeds within plant were also reported by Dharmalingam (1989) in different crops. Positional variation as described in many crops is highly possible in grain amaranth due to their basipetal flowering behaviour. The first developed seeds in the bottom position would attain physiological maturity earlier and exposed to weather condition and should have resulted in shattering of seed with lesser seed recovery from spike. The top region due to late flowering and difference in distance for translocation of nutrients from source to sink favoured the development of smaller sized seeds with less food reserves resulting in poor germination potential and vigour characters as late formed spike were in weak competitions in drawing nutrition under changing micro and macro environment when compared to the ones already under development on the bottom portion of the plant as expressed by Marnaville, (1977). Decrease in vigour of seed at the distal end may be due to adequacy of mobilisation of reserves for germination and it could not be compensated for further growth of the seedling which resulted in lesser vigour status (Abdul Baki and Anderson, 1973) as supported by Black, (1958) in Clover and Vadivelu and ramasamy, (1991) in Tomato. Such a study on positional polymorphism would be highly useful for grain amaranth in selection of best quality seed for next generation or in preservation on seeds for nucleus and breeder seed in adoption of successful seed production programme.

CONCLUSION

The fruiting and flowering period extended for 3 and 10 days respectively while the spike maturation occur 26 to 30 days after completion of flowering and the total duration of the crop from sowing to harvest was 83- 87 days and the seeds of middle portion of spike recorded higher values for seed and seedling quality characters and was found to be better than the seeds extracted from bottom or top portion of spike and also from the whole spike.

REFERENCES

Abdul-Baki A.A., J.D. Anderson (1973) Relationship between decarboxylation of glutamic acid and vigour in soybean seed. Crop Sci ., 13: 227-232.

Black C.V. (1973) Soil plant relationships. John wiley and sons, Inc., New York.

Dharmalingam C. (1989) Mungbean seed technology. Seeds and Farms, 15(5):23-25.

ISTA (1999) International rules for seed testing, Seed Science & Technology., 21:34-35.

Kalavathi D. (1997) Studies on seed viability and vigour in soybean (Glycine max (L.) merrille). M.Sc (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore.

Marnaville J.H., M.D. Clegg (1977) Influence of seed size and density on germination, seedling emergence and yield of grain sorghum. Agron. J., 69: 329-330.

Menaka C. (2000) Seed Technological studies in Amaranthus (A.tricolor) cv. CO 5.M.Sc (Ag) Thesis, Tamil Nadu Agricultural University, Coimbatore.

Mukerjee (2004) College botany. Volume III . New Central Book Agency (P) LTD. kolkata. pp 118 -120.

Sounders R.M, R. Becker (1983) Amaranthus: a potential food and feed resource, Adv. Cereal Sci. Technol. (6) pp. 357–396.

Srimathi P., K. R. Ramasamy (1992). Quality of seed relation to position of seed in the pods of cowpea. Madras Agric. J., 79(8): 448-450.

Srimathi P., R.S.VinayaRai, C. Surendran (1991). Studies on the effect of seed coat colour and seed size on seed germination in (Acacia mellifera) (Vahl) Benth. Indian J. For., 14 (1): 1 - 4.

Vadivelu K.K., K. R. Ramaswamy (1983) Effect of storage treatments and containers on seed germination and seedling vigour in tomato co 2. In proc. Of national seminar on the production technology of tomato and chillies, pp. 105-107.

Table 1. Studies on phenology of grain amaranthus cv. Suvarna

Characters	Days after sowing
Days for initiation of spike	40
Days for 50 per cent spike formation	42
Days for completion of spike formation.	43
Pattern of flowering	Basipetal
Days for initiation of flowering within a spike	47
Days for 50 per cent flowering within a spike	53
Days for completion of flowering within a spike	57
Number of spike plant $^{-1}$	Monospiked, up to 3 per cent had 2 spike plant-1
Number of spikelet spike^{-1}	50 - 65
Days for maturation	83 – 87

Table 2. Influence of positional polymorphism on seed quality of grain amaranthus cv. Suvarna.

Portions of spike / Characters	Top	Middle	Bottom	Whole spike	SEd	CD(P=0.05)
Seed recovery (%)	40	58	52	45	1.648	3.591
Graded seed recovery (%)	91	93	94	93	1.575	NS
100 seed weight (mg)	79	82	80	80	1.245	2.712
Germination (%)	93	98	96	93	2.071	4.308

Root length (cm)	4.7	5.5	5	5	0.168	0.366
Shoot length (cm)	3.7	4	3.9	3.9	0.136	0.296
Dry matter production 10 seedling $^{-1}$ (mg)	6	8	6.8	7.4	0.1	0.217
Vigour index	781	931	854	828	1.857	4.047

Table 3. Influence of positional polymorphism on seed quality of grain amaranthus after six months of storage

Portions of spike / Characters	Top	Middle	Bottom	Whole spike	SEd	CD(P=0.05)
Germination (%)	85	90	88	88	1.128	2.346
Root length (cm)	4.5	5.0	4.8	4.7	0.136	0.297
Shoot length (cm)	3.6	4.0	3.7	3.8	0.114	0.250
Drymatter production 10 seedling $^{-1}$ (mg)	5.5	7.4	6.3	6.4	0.179	0.391
Vigour index	688	810	748	746	2.503	5.454

Figure 1. Phenology of grain amaranthus cv. Suwarna

Figure 2. Grain Amaranthus spike position