can be used as important selection traits in order of merit to improve yield, quality and productivity of durum wheat under high input conditions.

References

Jaglan, R.S., Tandon, J.P. and Singh, M. (1997). Correlation studies in tall versus dwarf population of bread wheat. *Indian J. Agric. Res.* **31**: 19-22.

Khan, H.A., Shaik-Mohammad and Mohammad, S. (1999). Character association and path coefficient analysis of grain yield and yield components in wheat. *Crop Research*, **17**: 229-233.

Mondal, A.S., Chaudhary, S. and Ghosal, K.K. (1997). Genotypic and phenotypic variability in wheat. *Environment and Ecology*, **9**: 926-928.

Uddin, M.J., Biswanath, M., Chawdhary, M.A.Z. and Mitra, B. (1997), Genetic parameters, correlation, path coefficient analysis and selection indices in wheat. *Bangladesh J. Scientific and Industrial Research*, **32**: 523-528.

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Research Notes

Determination of physiological maturity of seeds in amaranthus cv. CO 5

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Amaranthus (*Amaranthus* spp.) is very nutritive and highly stable crop for kitchen garden and commercial cultivation Rapid growth and quick rejuvenation after each harvesting with high nutritive value are its important features. It is one of the cheapest leafy vegetables in tropical and sub tropical parts and it is very valuable source for combating under nutrition and mal-nutrition in India. Since the crop is regenerated through seeds, tracing its physiological maturity to harvest the crop with quality seeds assumes greater importance.

From the bulk crop of Amaranthus cv. CO 5 raised during *Kharif* 1999, the inflorescence were individually tagged. The inflorescence were collected at five days interval upto 30 days after anthesis. The inflorescence harvested at different stages were designated as S_1, S_2, S_3, S_4, S_5 and S_6 representing 5th, 10th, 15th, 20th, 25th and 30th days after anthesis, respectively. Observations on seed colour, moisture content, fresh weight, dry weight, germination (ISTA, 1999), root length, shoot length, dry matter production, vigour index were recorded. The vigour index value was calculated using the following formula (Abdul-Baki and Anderson, 1973).

VI= Germination (%) x Drymatter production (mg)

The colour of the developing seeds was white at 5th day after anthesis and changed to shiny dark black at 25th day after anthesis which indicates the physiological maturity of the seeds (Table 1). Higher moisture content of 52.0% was recorded on 15th day after anthesis and it was decreased to reach 28.0 per cent at 25th DAA (Days after anthesis) and further decrease was noticed at later stages. Per cent moisture of seed /kernels was originally used with the promise that the maturation process consisted of essentially water loss which is dependent upon atmospheric dry conditions (Appleman, 1923). It was reported that increasing moisture of harvested seeds, seedling vigour and viability were reduced. In a similar study, seeds harvested at 30% moisture had higher germination, vigour and yield than seeds harvested at lower or higher moisture. The moisture content is varied at physiological maturity in different crops like corn 25-35% (Carter and Poneleit, 1973) and barley 42-48% (Pinthus, 1963).

The fresh weight of seeds was also high at 25th DAA which is an important factor that

Table 1. Changes in seed colour, moisture content (%), seed fresh weight (g) and dry weight (g) during seed development and maturation

Stages of development	Seed colour	Moisture content (%)	Seed fresh weight (g/100 seed)	Seed dry weight (g/100 seed)
S_1	White	30.9	0.127	0.059
S_2	Light brown	45.7	0.128	0.064
S_3	Dark brown	52.0	0.132	0.078
S_4	Light black	43.5	0.135	0.087
S_5	Shiny dark black	28.0	0.146	0.108
S_6	Shiny dark black	19.1	0.115	0.097
Mean		36.5	0.132	0.082
SEd		0.707	0.002	0.002
CD (P=0.05)		1.506	0.005	0.006

Table 2. Changes in germination (%), root length (cm), shoot length (cm), drymatter production (mg) and vigour index during seed development and maturation

Stages of development	Germination (%)	Root length (cm)	Shoot length (cm)	Drymatter production (mg/ 20 seedlings	Vigour index
S_1	-	-	-	-	-
S_2	-	-	-	-	-
S_3	15 (22.79)	4.0	2.4	2.20	31
S_4	22 (27.97)	5.0	2.9	4.00	89
S_5	32 (34.45)	6.0	3.9	7.15	226
S_6	24 (29.33)	3.2	2.2	3.10	82
SEd	0.977	0.094	0.070	1.000	19.420
CD (P=0.05%)	2.083	0.200	0.150	2.000	41.400

(Figures in parentheses indicate arcsine transformed values)

determines quality of seeds. Abul-Baki and Anderson (1973) used the fresh weight for differentiating seed development and maturation. The maximum dry weight of 0.108g was recorded on 25th DAA (Table 2) which indicated the large amount of reserve food substances went on accumulating in the seeds till 25th day after anthesis. The determination of physiological maturity was done on the basis of measuring maximum dry weight accumulation in oat (Lee *et al.* 1978) Delouche (1974) found that soybean seed attained maximum dry weight and full germination potential at physiological maturity.

The root length and shoot length, dry matter production (7.15 mg), germination (32%) and vigour index (226) were also at the maximum at 25th DAA (Table.2). A delay of two weeks in harvesting soybean adversely affected the proportion of smooth seeds, wrinkled seeds, cracked seeds and laboratory germination (Dao and Hariharram, 1996). The higher germination and subsequent growth and vigour of seeds at 25th DAA could be attributed to maximum dry matter accumulation of the seeds which might have provided more energy in the growth process. Harrington (1972) stated that physiological maturity of the seeds is the stage at which the seed attains its maximum dry weight and it represents the stage of seeds marked with maximum viability and vigour. Jaya *et al.* (2001) reported that in chilli, delay in the harvest leads to decline in seed quality.

From the results of the study it could be concluded that the seeds of Amarathus cv.

CO 5 attained physiological maturity after 25 days of anthesis with maximum germination and vigour which is the optimum stage harvesting for quality seeds.

References

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

Appleman, C.O. (1923). Forecasting the date and duration of the best canning stage for sweet corn. Md. Agri. Exp. Stn. Bull. 254, p.10.

Carter, M.W. and Poneleit, G.G. (1973). Black layer maturity and filling period variation among lines of corn (*Zea mays* L.) *Crop Sci.* **13**: 436-439.

Dao, P., and Hariharram. (1996). Effect of harvest on seed quality of soybean (*Glycine max*). *Indian Journal of Agricultural Sciences*, 66: 711-3.

Delouche, J.C. (1974). Maintaining soybean seed quality. *In*: Soybean production, marketing and use, pp.46-61. BulIY-19TVA. Muscle, Shoals, ALA.

Harrington, J.P. (1972). Seed storage and longevity *In*: Seed Biology (Ed.) I.T.Kozlowski, 3:145-245. Academic press, New York and London.

ISTA. (1999). International rules for seed testing. *Seed Sci. & Technol.* **27**: Supplement rules, 27-31.

Jaya, R.R.P., Rama Rao, G., Narasimha Rao, K.L., Subba Rao, D.V. and Mahalakshmi, B.K. (2001). Studies on physiological maturity in chilli (*Capsicum annum* L.). *Seed Res.* **29**: 93-94.

Lee, H.J., Mckee,G.W. and Khievel, D.P. (1978). Determination of physiological maturity in oat. *Agron. J.* **71**: 931-935.

Pinthus, M.J. (1963). Comparison of dry matter accumulation and moisture content in the developing kernels of bread wheat, durum wheat and barley. *Israel J. Agric. Res.* **13**: 117-124.

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Research Notes

Seed invigouration studies with parental lines of sunflower hybrid BSH 1

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Sunflower is one of the important international oilseed crops with economic importance. The seeds of sunflower exhibit microblotic orthodox behaviour in storage and fall to exhibit the minimum requirement of germination (70 per cent) for certification (Tanwar and Singh, 1988) upto the validity period of 9 months. Physico chemical irreversible deterioration, the prime factor for reduction of seed germination during storage is said to be at higher order in sunflower due to their higher oil content. BSH 1 is the first public sector sunflower hybrid released from Karnataka with the parental lines of CMS 234 A and RHA 274. Studies on mid storage invigouration in these parental lines are very meager. Hence, studies were taken up on invigouration aspect with various antioxidants as such studies would be much useful in prolonging the shelf life of the highly valuable parental lines of sunflower hybrid.

The bulk seeds of parental lines of BSH 1 (CMS 234 A and RHA 274) were cleaned and graded with 9/64" round perforated metal sieve for uniformity and were stored in fresh gada cloth bags at 8-9 per cent moisture content under ambient conditions of Colmbatore (32 ± 2°C and 75 ± 2% RH) during 2000. The germination had reduced to 75 per cent just five per cent higher than the Minimum Seed Certification Standard (MSCS) after five months