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Seed Development, Maturation and Germination Improvement in Gaillardia

A. BHARATHI, V. PALANISAMY, K. RAJA, P. NATESAN, V.KRISHNASAMY AND K. VANANGAMUDI
Department of Seed Science & Technology, Tamil Nadu Agrl. University, Coimbatore - 641 003.

Abstract : An Experiment was conduced at Horticultural Research Station, Udhagamandalam to trace the pattern of seed development and maturation as well as improving the germination and seedling growth of gaillardia for profuse and healthy flower production. The result revealed that seeds of gaillardia attained physiological maturity at 40 DAF (Days After Flowering) where the germination and dry weight of seedlings were at their maximum level with a moisture content of 21.4 per cent. Soaking the seeds in GA_3 @ 100 ppm for 8 hr recorded higher germination (90.0%), speed of germination (6.8), seedling length (140 cm), drymatter production (0.048 g seedling^{-10}) and vigour index (1260) compared to other treatments. It is concluded that in order to obtain quality seeds of gaillardia, the flowers have to be harvested at 40 days after anthesis for extraction of seeds and germination of gaillardia can be improved by soaking the seed in GA_3 @ 100 ppm for 8 hr.

Key words: Gaillardia, seed development and maturation, germination improvement

Introduction

Gaillardia is generally grown as an annual commercial flower crop. It blooms continuously throughout summer and fall without deadheading. Flowers are flat to nearly ball-shaped with yellow or red or mixed colour such as red with yellow tips. In order to obtain high quality seeds, the seeds are to be harvested rightly at maturity, the terminal phase of seed development is marked with gradual desiccation of the seed leading to a state of metabolic quiescence. The level of viability and vigour are determined by the extent of seed development when the crop is harvested (Fussel and Pearson, 1980). The demand for high quality seeds of annual commercial flower crop has increased greatly in the recent years. Tracing the pattern of seed development and assessing the time of maturity have great practical utility to obtain the seeds with good quality characteristics. It is of great interest for plant producers to find a chemical which stimulates growth of plants, branching, lateral bud development, flowering and seed set. Growth regulators are used as seed treatment for breaking dormancy as well as germination improvement. The growth regulators antagonise the effect of growth inhibitors and also enhance the rate of metabolism during germination (Verma and Tandon, 1988). Seed treatment with Gibberellin increases the seed germination and seedling survival percentage (Ankaiah *et al.,* 1993). Seed soaking in Ethephon and IBA enhances the germination (Prasad *et al.,* 1996). In recent years, a few works were made on the promotion of germination in annual flower crops. Therefore, a knowledge on the development of seed from fertilization to physiological maturity and effect

Table 1. Study on maturity indices on the flower crop-Gaillardia.

Parameters	Days after anthesis								Mean	CD
	5	10	15	20	25	30	35	40		(P=0.05)
Fresh wt. of flower (g)	0.784	1.819	1.418	1.404	0.377	0.217	0.143	0.106	0.783	0.1302
Dry wt. of flower (g)	0.107	0.258	0.268	0.240	0.317	0.180	0.093	0.040	0.192	0.0498
Moisture content of flower (%)	87.3	84.1	80.8	72.0	61.9	-	-	-	42.3	0.9024
Weight of flower head (g)	0.577	1.554	1.174	1.213	0.375	0.289	0.171	0.171	0.118	0.2464
Diameter of head (cm)	15.8	25.8	26.5	31.0	19.0	12.3	5.5	3.3	17.4	0.5110
No.of fertile florets head^{-1}	-	-	-	-	117.0	94.8	112.3	117.5	55.9	1.1351
Seed weight (g)	-			-	0.245	0.198	0.165	0.171	0.097	0.0127
Seed moisture content (%)	-	-	-	-	37.8	37.9	34.5	21.4	16.5	1.3629
Germination (%)	-	-	-	-	3.8	4.5	67.0	91.0	25.9	0.7866
					(11.10)	(12.4)	(54.9)	(72.8)	(22.6)	
Seedling length (mm)	-	-	-	-	11.8	15.3	16.4	188	13.75	0.7353
DMP (mg/10 seedlings)	-	-	-	-	9.2	12.4	13.5	15.3	6.3	0.4015
100 Seed weight (mg)	-	-	-	-	170.5	178.5	186	201	92	0.5720

(Values in parenthesis indicate arcsine values)

of chemicals on germination improvement for quality seedling production will be valuable for commercial flower crop - Gaillardia.

Material and Methods

The gaillardia seeds after grading were sown in the raised nursery beds. After thirty five days the seedlings were pulled out from nursery and transplanted in the main field in Horticultural Research Station, Udhagamandalam. The plants were transplanted with recommended spacing. Recommended cultivation practices and plant protection measures were followed during the period of crop growth. At the time of flowering, sufficiently large number of flowers were tagged, considering the time of anthesis as the main criteria for determination of physiological maturity of seeds. The flower heads were collected from five replications periodically at five days intervals *viz.*, 5, 10, 15, 20, 25, 30, 35 and 40 days after flowering. The flower quality, seed yield and seed quality attributes were recorded. Harvested seeds of gaillardia were cleaned, graded and brought to homogeneity. The seeds were soaked in water and the growth promoting chemicals *viz.*, GA_3 @ 100 and 500 ppm,thiourea @ 100 and 200 ppm, KNO_3 @ 0.5and 1% and ethrel @ 100 and 200 ppm for 8 hrs. Seeds were also leached out in running water for 8 hr. After soaking, the seeds were washed with water and surface dried to bring back its original

Table 2. Influence of seed soaking treatments on seed germination and seedling vigour in Gaillardia

Treatmens	Germination (%)	Speed of germination	Root length (cm)	Shoot length (cm)	Dry weight (g seedling^{-10})	Vigour index
Control	64.0 (53.2)	4.9	2.7	3.3	0.027	388
Water	80.0 (63.50	5.2	4.8	5.3	0.029	498
Leaching	68.0 (55.6)	4.1	3.4	3.1	0.019	442
GA_3 @ 100 ppm	90.0 (71.6)	6.8	6.8	7.2	0.048	1260
GA_3 @ 500 ppm	83.3 (65.9)	6.1	5.7	5.9	0.038	973
Thiourea @ 100 ppm	72.0 (58.1)	5.5	4.8	4.4	0.026	659
Thiourea @ 200 ppm	72.7 (58.5)	4.8	4.5	4.8	0.031	673
KNO_3 @ 0.5%	80.0 (63.50	5.5	5.7	5.6	0.035	898
KNO_3 @ 1%	67.3 (55.2)	5.6	3.3	3.2	0.023	440
Ethrel @ 100 ppm	84.7 (67.0)	5.3	6.7	6.1	0.045	670
Ethrel @ 200 ppm	64.0 (53.2)	4.9	2.7	3.3	0.027	388
SEd	2.81	0.26	0.40	0.44	0.003	98.0
CD (P=0.05)	5.83**	0.55**	0.82**	0.91**	0.055**	203**

(Values in parenthesis indicate arcsine values)

moisture content (8%). Seed samples were taken at random and tested for the following seed quality attributes like germination (ISTA 1999), speed of germination (Maguire, 1962) and vigour index (Abdul-Baki and Anderson, 1973). The data were statistically analysed using the procedure described by Panse and Sukhatme (1978).

Result and Discussion

Seed development and Maturation

The experiment results revealed that in gaillardia, seed formation starts from 25 days after flowering with germination of only 3.8%. The seed attained physiological maturity at 40 days after flowering and recorded the highest germination (91.0%), dry weight of seedlings (15.3 mg/10 seedlings) with a seed moisture content of 21.4% for obtaining good quality seeds of gaillardia. The moisture content of flower head during initial stage was 87.3 per cent and decreased to 61.9 per cent at 25 DAF. The moisture content at 25 DAF was 37.8 per cent and decreased to 21.4 per cent at 40 DAF. The decrease in moisture content with advancement in maturity stage might be due to desiccation and dehydration of seed (Miyajima,1997). This might also be due to replacement of osmotic material by starch and other large molecule with low hydration capacity (Milthorpe and Morrby, 1974).

The developing seeds attained the potential for germination at 25 days after flowering. There was a gradual increase in germination as the seed matures and reached the maximum

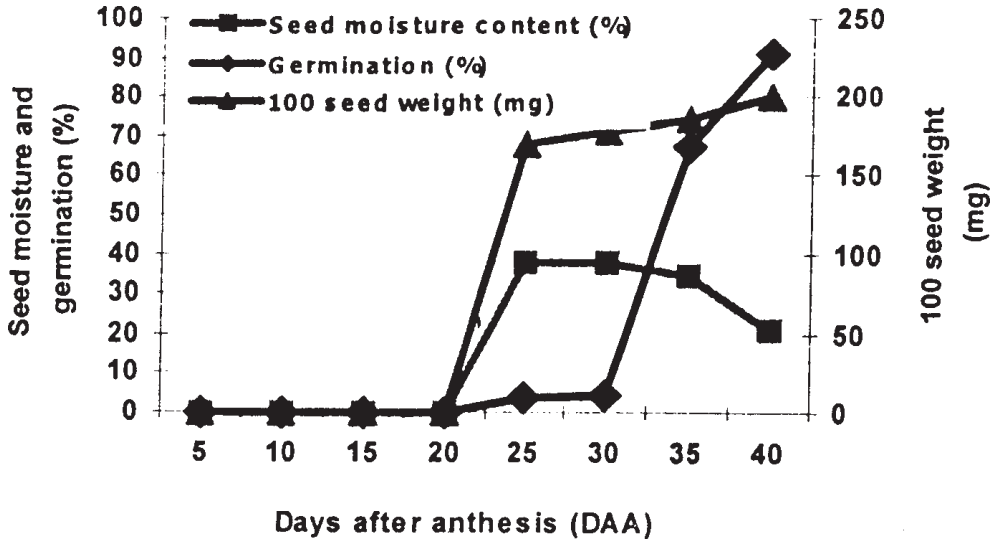

Fig.1 Changes in seed moisture content on seed quality attributes during seed development in Gaillardia

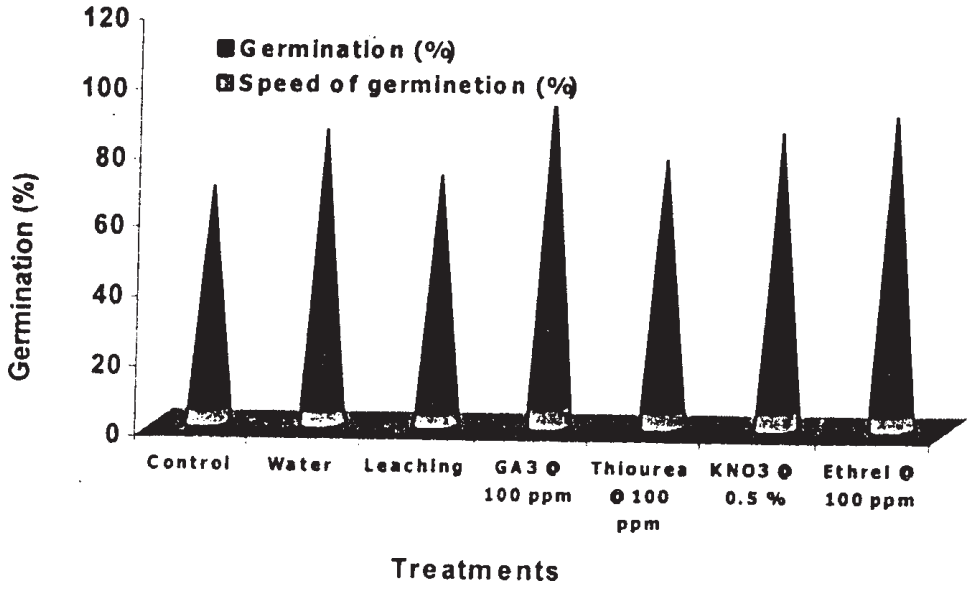

Fig.2 Seed soaking treatments on germination and speed of germination in Gaillardia

on 40 DAF. This is in conformity with Raja and Palanisamy (1998) in tuberose. The seedling length and drymatter production increased from the initial stages of maturation upto 40 DAF. This was due to higher accumulation of drymatter production at maturity. Similar results were obtained by Raja and Palanisamy (1998) in tuberose.

The attainment of higher germination was coincided with the attainment of maximum dry weight of seed. Vijaya *et al.* (1998) reported that the maximum germination and vigour always coincided with the attainment of highest dry weight of the seeds. Loss of water from the seeds play an important role in the transition of a developing seed into a germinable seed (Misra *et al.*, 1985).

Germination improvement

Seeds soaked in GA_3 @ 100 ppm significantly registered higher germination percentage (90.0), speed of germination (6.8) root length (6.8 cm), shoot length (7.2 cm), drymatter production (0.048 g / 10 seedling) and vigour index (1260). Similar reports on the efficiency of GA_3 in enhancing the germination and other seedling characters were reported by Raja and Palanisamy (1997) in tuberose. The enhancement of germination might be attributed to stimulation of hydrolytic enzyme activity or synthesis of the same known to be induced by gibberellic acid. This led the various promotive stimuli act at different steps of the metabolic sequence leading to germination. After germination, in the zone of cell division increased in length commensurate with increase in length of seedlings (Sachs, 1965). The gibberellin markedly stimulates the hydrolysis of endospermal reserves, it also albeit indirectly, enhances the growth of seedling roots and dry matter production (Raja and Palanisamy, 1997). This results is in conformity with the results obtained by Vijayan (2002).

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