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SEED AND SEEDLING PHYSIOLOGY IN TWELVE GENOTYPES OF BAJRA*

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Twelve genotypes of bajra which have been grouped into high, medium and low yielders varying in morphological characters and yield were employed in the study. The high yielders recorded relatively high values for germination percentages, rate of germination, vigour index and low values for electrical conductivity as compared to the medium and low yielders. Among seedling characters, the vigour index appeared to be a very dependable criterion and had a positive correlation with germination percentage, rate of germination and field emergence, thus deserving to be a handy index for selecting genotypes.

In bajra, the variation in yield has been rather very wide as compared to many of the cereals and pulses. Further, the physiological aspects reflecting on yield has not been particularly studied in bajra as compared to rice, wheat, maize or sorghum. With the advancement in F_1 breeding, the physiological emphasis on this crop becomes more relevant, to increase the production by employing desirable genotypes. With the above objects in view, several characters relating to seed and seedling physiology were screened in 12 genotypes under laboratory conditions.

MATERIALS AND METHODS

The primary object of the present laboratory investigation was to enquire into the differences in the seed and seedling physiology among the twelve genotypes of bajra. The chosen genotypes comprised four low yielding, four medium yielding and four high yielding ones. The reported studies were carried out during 1979-80 in the Department of Crop Physiology, Tamil Nadu Agricultural University, Coimbatore-3.

The twelve genotypes of bajra included in the study were KM 2. X 4 MS 7373, CO 6, ICI 7616, MS 7358, PT 962, PT 1482, PT 1484, PT 1485, PT 1846 and PT 1890. The aspects relating to the variation in the seed and seedling physiology of the selected genotypes studied in the laboratory were (i) water absorption rate, (ii) germination (Anon., 1976), (iii) field emergence, (iv) rate of germination (Maguire, 1962), (v) shoot length, (vi) root lenght, (vii) dry weight of shoot, (viii) dry weight of root, (ix) vigour index (Abdul-Baki and Andersont 1973), (x) electrical conductivity of seed leachate and (xi) protein conten. (Lowry *et al.*, 1951).

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RESULTS AND DISCUSSION

Regarding the water absorption rate there was a progressive increase in water absorption from initial duration of 4 to 24 hr (Table 1). Generally, the intactness of seed coat which is under genetic control. plays an important role in water absorption. This was true in genotypes of bajra in which the seeds of high yielders and to some extent those of the medjum yielders recorded low water absorption rate, when compared with those of low yielders. The highest value of 51.5 per cent was recorded in PT 1890.

Generally, germination and seedling growth proceed at a speed and extent predetermined by genetic makeup of the species under adopted conditions, according to Ching (1973). The high yielders recorded the maximum germination percentage ranging from 99 to 100; the medium and low yielders registered 63 to 98 and 40 to 98 per cent germination, respectively (Table 2).

Rate of germination, an expressin of seed vigour (Maguire, 1962) differed among the genotypes of bajra depending upon the variability in vigour due to genetic causes. It was higher, 32 to 33 in high yielders than 25 to 32 and 13 to 32 recorded in medium and low yielding genotypes, respectively. The amount of food reserves present in the seed controls the rate of germination and subsequent seedling development. Seed protein content is yet another factor which is closely associated with the rate of germination and seedling growth (Schweizer and Ries, 1969). The protein content of seed in high yielders ranged from 11.7 to 14.4 per cent, in medium yielders from 9.0 to 12.1 per cent and in low yielders from 10.0 to 10.9 per cent.

The relative length of root and shoot of the germinated seedling varied among the genotypes, The seedling of the high yielder X 4 characterised by the high seed vigour produced the longest root. Relevant to the present findings are the results obtained by Woodstock and Feeley (1965) in regard to root growth found positively associated with the vigour status of the seed in corn.

A significant and positive correlation was observed between vigour index and germination ($r = 0.9021^{**}$), as well as with rate of germination ($r = 0.8081^{**}$) and field emergence ($r = 0.9893^{**}$).The genotypes differed significantly in respect of vigour index. In the chosen genotypes, besides the high yielders, some of the medium yielders also showed high vigour index, thereby suggesting their potentiality. The low seedling vigour observed in low yielders may be due to slow seedling growth.

In general, the dry weight of shoot and root of the germinated seedlings was more in high yielders than medium and low yielders. This again was dependent more upon the rapidity with which the seedlings were able to grow and reach the autotropic stage. Qualls and Cooper (1968) stated that the seedling vigour was usually characterised by the weight of the seedlings after a certain period of growth.

Field emergence was higher from seeds of high yielders than those from of medium and low yielders. According to perry (1969), the emergence of some cultivars of peas was significantly lowered indicating that there were cultivars with some form of genetially determined low vigour and the plants that emerge from low vigour seeds, therefore, have a lower yield potential than those from high vigour seed.

The loss of membrane intēgrity reflecting the vigour status of the seeds, when measured by the electrical conductivity of the seed-steep water, was witnessed to a large extent in medium and low yielding genotypes compared with the high yielding ones. The variation in this phenomenon in the absence of variabilty in other causes inflicting membrane damage, could be related only to genetic causes. According to Matthews and Bradnock (1968), more soluble carbohydrates and electrolytes are leached from low vigour than from high vigour seed, and this lends support to the present findings that the medium and low yielding genotypes are less vigorous than the high yielding ones.

Table 1. Water absorption rate in 12 genotypes of bajra

Genotypes	Percentage of increase in water absorption on weight basis					
	4	8	12	16	20	24 hours
KM 2	30.65	34.52	37.58	42.55	44.13	46.54
X 4	30.15	37.40	41.71	43.65	44.41	45.05
MS 7373	32.71	42 02	43.34	48.15	48.70	48.98
CO 6	34.80	43.45	43.69	49.75	51 41	52.25
ICI 7616	30.65	35.99	37.59	42.22	43 43	45.09
MS 7358	34.97	43.15	44.09	44 84	45.24	45.62
PT 962	40.30	48.24	50.60	52.40	53.04	55.39
PT 1482	41.36	49.32	50.02	50.05	51.89	52.65
PT 1484	44.85	49.59	50.86	52.28	53.48	54.79
PT 1845	33.02	39.60	43 05	47.00	49.76	50.27
PT 1846	38.22	42.33	43.62	44.16	45.43	45.93
PT 1890	51.50	58.83	60.50	61.72	62.63	63.62

	SE_{d}	CD
Genotypes	0.17	0.34**
Duration of soaking	0.12	0.24**
Duration x Genotypes	0.41	0.83**

Table 2. Seed and seedling physiology of 12 genotypes of bajra

Geno-types	Germination (%)	Rate of germination	Shoot length (cm)	Root length (cm)	Vigour index	Shoot dry weight (mg)	Root dry weight (mg)	Field emergence (%)	protein content (%)	Electrical conductivity(micro-mhos/cm)
KM 2	99	33	10.4	21.8	3195	43	21	98	14.4	24
X 4	96	32	9.6	25.1	3343	40	16	96	13.1	26
MS 7373	97	32	10.8	21.6	3154	40	14	94	12.3	34
Co 6	100	33	9.7	22.1	3193	35	16	99	11.7	29
ICI 7816	98	32	9.2	21.1	2989	32	14	96	11.8	30
MS 7358	82	26	8.5	20.0	2345	31	16	82	10.0	42
PT 962	63	20	3 6	8.7	785	19	6	64	9.0	44
PT 1482	77	25	10.2	20.1	2337	31	15	76	12.1	40
PT 1484	91	29	9.5	20.1	2713	28	9	91	10.1	36
T 1845	86	28	8.5	19.5	2416	27	10	85	10.7	29
PT 1846	98	32	9.0	20.5	2883	25	12	98	10.5	31
PT 1890	40	13	10 2	18.9	1173	24	11	40	10.9	49
CD	7**	2.0**	0.9**	0.9**	292**	3**	NS	9**		
SE —d	3	1.0	0.4	0.4	144	1	—	4	—	—

Table 3. Correlation matrix of chosen parameters in seed and seedling physiology

Parameters	Germination percentage	Rate of germination	Shoot length	Root length	Vigour index	Shoot weight	Root weight	Field emergence
Germination percentage	—	0.7517**	0.1773	0.2213	0.9021**	0.6759**	0.4696**	0.5782**
Rate of germination		—	0.0633	0.1882	0.8081**	0.3519**	0.2921*	0.6995**
Shoot length			—	0.6748**	0.5247**	0.5633**	0.4875**	0.8348**
Root length				—	0.8439**	0.7813**	0.6659**	0.6358**
Vigour Index					—	0.8390**	0.5484**	0.9893**
Shoot weight						—	0.9636**	0.6630**
Root weight							—	0.4706**
Field emergence								—

The germination percentage was highly and significantly correlated with the rate of germination, vigour index, root weight, shoot weight and field emergence (Table 3). But there was no relationship between germination and root and shoot length. A positive relationship between rate of germination and vigour index, as well as field emergence, was evident. A significant and positive correlation was observed between vigour index and each one of other parameters such as dry weight of root and shoot, field emergence, rate of germination and germination percentage, Field emergence was an important characters, which showed high significant correlation with all the charactets studied. Germination and rate of germination were associated with field emergence, but both were independent. Shoot length and root length were also associated with field emergence. No relationship between root length, shoot length germination percentage and rate of germination was observed in bajra genotypes.

REFERENCES

ABDUL-BAKI, A. and J. D. ANDERSON. 1970 Viability and leaching of sugars from germinating barley. Crop *Sci.* 10 : 31-35,

ANONYMOUS. 1976. International rules for seed testing. *Seed Sci.* and *Techcol.*, 4 : 3-49.

CHING, T. M. 1973. Biochemical aspects of seed vigour.*Seed Sci*, and *Technol.*, 1 : 73-88

LOWRY, O., H. N. J. ROSETEROUGH, L. A. FARR and R. J RANDALL. 1951. Protein measurement with folin phenol reagent *J. Biol. Chem.*, *193* : 265-275.

MAGUIRE, J. D. 1962. Speed of germination- Aid in selection and evaluation for seedling emergence and vigour. *Crop Sci.*, *2* : 176-177.

MATTHEWS, S. and W. T. BRADNOCK. 1967. The detection of seed samples of wrinkle seeded peas (*Pisum sativum*) of potentially low planting value. *Proc. Int. Seed test Assoc.*, *32* . 553-563.

PERRY, D. A. 1969. Seed vigour in peas (*Pisum sativum L*). *Proc. Int Seed Test Assoc.*, *34* : 221-232,

QUALLS. M., and C S COOPER. 1968. Germination growth and respiration rates of birdfoot trefoil at three temperatures during the early non-photosynthetic stage of development. *Crop Sci.*, *8* . 758-760.

SCHWEIZER, C. J. and S. K RIES. 1969. Protein content of seed : Increase improves growth and yield. *Science.*, *165* : 73-75

WOODSTOCK, L. W. and J. FEELEY. 1965. Early seedling growth and initial respiration rates as potential indicators of seed vigour in corn. *Proc. Assoc. Off. Seed. Anal.* *55* : 131-139.