Agriculture Update
Volume **12** | TECHSEAR-8 | 2017 | 2142-2145
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RESEARCH ARTICLE :

Identification of drought tolerant and high yielding genotypes in ragi under rainfed conditions

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ARTICLE CHRONICLE :
Received :
20.07.2017;
Accepted :
16.08.2017

SUMMARY : A Field experiment was conducted at Agricultural Research Station (millets), Perumallapalli, Tirupati during *Kharif*, 2015 to identify the suitable traits which are more resistant to drought and also high yielding in finger millet. The treatment consists of 10 genotypes *viz*, G_1:PPR-1012, G_2:PPR-2885, G_3:PPR-2773, G_4:BR-36, G_5:PPR-1044, G_6:PPR-1040, G_7:PR-10-30, G_8:Sri chaitanya, G_9:Vakula and G_{10}:Hima. The experiment laid out in factorial randomized block design replicated thrice. Imposition of moisture stress from panicle initiation to grain filling stage significantly reduced all the yield parameters. Among all the other experimented genotypes G4: BR-36 performed well under moisture stress conditions and recorded highest values in terms of drought tolerant traits (SCMR (SPAD Chlorophyll Meter Reading), Chlorophyll Stability Index (CSI), Relative Water Content (RWC), Root length and Proline content) and yield attributes (No. of tillers per plant, no. of fingers per ear head, 1000 grain weight, grain yield, straw yield and harvest index) also. G_4:BR-36 performed well compared to G_3:PPR-2773 followed by G_1:PPR-1012 in terms of most of the drought tolerant traits. Hence, G_4: BR-36 and G_1:PPR-1012 followed by G_3:PPR-2773 genotypes performed well and recorded higher yields under rainfed conditions and better suitable for drought conditions.

KEY WORDS :
Finger millet, Genotypes, Drought tolerant traits, Yield attributes

How to cite this article : Aparna, K. and Bhargavi, H. (2017). Identification of drought tolerant and high yielding genotypes in ragi under rainfed conditions. *Agric. Update*, **12** (TECHSEAR-8) : 2142-2145.

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BACKGROUND AND OBJECTIVES

Finger millet is a staple food crop for drought prone areas of the world and it is considered to be an important crop for food and nutritional security. In India it is an important crop amongst the small millets and third in its importance among millets, in the country in area and production after sorghum and pearl millet. It is cultivated mostly as a rainfed crop in India under diverse production environments. In India the crop is grown in an area of 1.6 million ha with a production of 2.1 million t and productivity of 1.3 t ha^{-1} (Krishnappa *et al.*, 2009).Finger millet is highly nutritious as its grains contain 65-75% Carbohydrates, 5-8 % protein, 15 -20% dietary fibre and 2.5-3.5 % minerals (Chetan and Malleshi 2007). It has been found that protein of finger millet is biologically complete as in the case of milk. In addition high calcium, high soluble fibre and poly phenol, high diastatic power of malted grains coupled with starch that is more resistant to hydrolysis than of other cereals (Kalloo, 2004). It is good for infant feeding and also nutritionally rich food for adults. Further there is a great demand for finger millet due to increase in the number of diabetic patients. Generally lower yields in finger millet are due to lack of high yielding varieties and not adoption of improved cultural practices by the farmers in the dry land farming. Most of the farmers considering the crop as less valued and also growing under less moisture available conditions. There is a need to improve the yield potentiality coupled with drought tolerance. Keeping this objective in view, work was initiated to evolve new high yielding and drought tolerant finger millet genotypes to promote cultivation of this crop under rainfed conditions.

RESOURCES AND METHODS

A Field experiment was conducted at Agricultural research station (millets), Perumallapalli, Tirupati during *Kharif*, 2015 to identify the suitable genotypes which are more resistant to drought and high yielding in finger millet. The experiment laid out in factorial randomized block design replicated thrice. The soil of the experiment site was in neutral condition with low organic matter. Essential fertilizers (90 kg N, 40 kg P_2O_5 and 40 kg K ha^{-1} were applied through urea, single super phosphate and muriate of potash) and plant protection measures were taken as per recommendations. Entire dose of fertilizers were applied as basal at the time of sowing. The treatment consists of 10 genotypes *viz*, G_1:PPR-1012, G_2:PPR-2885, G_3: PPR-2773, G_4:BR-36, G_5:PPR-1044, G_6:PPR-1040, G_7:PR-10-30, G_8:Sri chaitanya, G_9: Vakula and G_{10}:Hima. Destructive and non destructive Sampling was done at 15 days interval. Data on different drought tolerant traits and also on yield attributes were recorded at harvest. Economics was calculated based on present market price of yield and inputs.

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads :

Drought tolerance traits :

Water use efficiency :

Specific leaf area (cm^2 g^{-1}) (SLA) :

The genotype BR-36 (83.62), PPR 2773 (72.88), sri chaitanya (68.53) and PPR-1012 (67.46) maintained numerically higher SLA values compared to all other genotypes. Hima (43.59) being short statured genotype recorded low SLA in rainfed treatments.

SPAD Chlorophyll meter reading (SCMR) :

Among the genotypes tested, BR-36 (31.18) recorded highest SCMR followed by PPR-2773 (29.96) compared to other genotypes. These genotypes maintained higher SCMR values in spite of moisture stress due to rainfed condition.

Chlorophyll stability index (CSI) :

The chlorophyll stability index is an indication of the stress tolerance capacity of plants. Significant differences

Table 1: Evaluation of ragi genotypes for drought tolerant traits under rainfed conditions

Genotype	SLA (cm^2 g^{-1})	SCMR	CSI	RWC (%)	Root length (cm)	Proline content (μg g^{-1})
PPR-1012	67.46	28.23	78.047	87.3	27.15	0.748
PPR-2885	50.71	26.3	77.465	88.7	18.79	0.475
PPR-2773	72.88	29.96	78.509	87.2	26.39	0.532
BR-36	83.62	31.18	81.177	92.2	22.78	0.768
PPR-1044	65.14	25.81	76.648	87	19.89	0.463
PPR-1040	63.05	27.74	73.336	88.9	21.68	0.470
PR-10-30	63.25	26.3	70.491	90.2	25.38	0.353
Sri Chaitanya	68.53	27.9	71.855	87.6	20.24	0.358
Vakula	64.58	28.89	77.397	88.9	19.33	0.713
Hima	43.59	22.13	71.43	85.4	17.12	0.39
Mean	64.29	27.74	75.64	88.34	21.88	0.527
S.E. ±	4.41	1.4139	3.9904	4.8305	1.9866	0.038
C.D. (P=0.05)	2.7892	4.0489	NS	NS	NS	0.1087

NS= Non-significant

were observed among the cultivars and treatments. Due to moisture stress CSI decreased significantly. The genotypes BR-36 (81.17) followed by PPR-2773 (78.5), PPR-1012 (78.04) maintained significantly high values of CSI compared to other genotypes under moisture stress conditions. A higher CSI helps in with standing stress through better availability of chlorophyll (Meghanatha *et al,* 2007).

Relative water content (%) (RWC) :

The genotype BR-36 (92.2) recorded highest RWC values followed by PPR-10-30 (90.2), vakula (88.9) compared to all other genotypes and lowest is Hima (85.4) during moistures stress conditions. This deviation in RWC may be attributed to differences in the ability of the variation to absorb more water from the soil and or the ability to control water loss through the stomata. These findings are in agreement with those reported by Sinclair and Ludlow (1985).

Root length (cm) :

Significant differences were not observed between genotypes, treatments and interactions throughout the duration, except initial differences between genotypes 15 and 30 DAS.

Among the genotypes PPR-1012 (27.15) recorded numerically higher root length values followed by PPR-2773 (26.39), PR-10-30 (25.38) and BR-36 (22.78) compared to all other genotypes especially under rainfed treatments.

Proline content (µg g^{-1}) :

Accumulation of proline has been advocated as a parameter of selection for stress tolerance. BR-36 (0.768) recorded highest proline values followed by PPR-1012 (0.748) compared to all other genotypes and lowest is Hima during moistures stress conditions (Ramanjulu and Bartels, 2000).

Yield attributes :

Number of tillers per plant :

Among the genotypes BR-36 (4.13) recoreded highest no.of tillers per plant followed by PPR-2773 (4.08), PPR-1012 (4.07). The reduction in number of tillers is an adaptive mechanism that has been induced in response to water stress. This reduction reduces the transpiration area and hence, helps the plant to withstand against water stress. Similar findings were reported by Mahalakshmi and Bidinger (1985).

Number of fingers per ear head :

Among the genotypes BR-36 (17.94) recoreded highest no.of fingers per ear head followed by PPR-2773 (16.65), PPR-1012 (15.99). Fingers per ear head was significantly reduced due to imposition of stress at panicle initiation stage, denoting the fact that number of fingers is affected irrespective of moisture stress.

1000-grain weight (g) :

Moisture stress at 47-67 DAS decreased 1000-grain weight. Among the genotypes PPR-2773 (2.87) recoreded highest 1000 grain weight followed by BR-36

Table 2: Evaluation of ragi genotypes for yield attributes under rainfed conditions

Genotype	No. of tillers per plant	No. of fingers per ear head	1000 grain weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index (%)
PPR-1012	4.07	15.99	2.43	1920.09	5224.77	29.29
PPR-2885	2.93	15.77	1.84	985.17	4725.67	18.38
PPR-2773	4.08	16.65	2.87	1406.72	4633.49	29.47
BR-36	4.53	17.94	2.55	1901.45	4911.6	42.35
PPR-1044	2.67	15.54	2.26	977.73	4039.64	20.05
PPR-1040	2.67	14.98	1.6	1688.87	4123.76	25.01
PR-10-30	3.2	13.63	2.02	899.97	3655.56	18.64
Sri Chaitanya	2.87	14.28	2.51	1659.23	4256.97	17.44
Vakula	3.33	14.94	2.04	1704.13	4494.69	24.57
Hima	2.4	9.33	1.6	1085.13	3515.78	20.38
Mean	3.224	14.905	2.16	1715.04	4388.67	24.558
S.E. ±	0.3988	1.1958	0.196	18.2995	0.0544	4.41
C.D. (P=0.05)	1.1419	3.4245	0.562	52.1461	0.1558	12.63

(2.55) and PPR-1012 (2.43). This is likely due to the shortage of moistures which forces plant to complete its grain formation in relatively lesser time when compared to tolerant genotypes (Maqsood and Ali 2007).

Grain yield (kg ha^{-1}) :

The present study evaluated three identified genotypes PPR-1012(1920.09), BR-36 (1901.45) and PPR-2773 (1406.72) which possess high grain yield. Hence, these genotypes are more suitable for rainfed conditions.

Straw yield (kg ha^{-1}) :

Among the genotypes PPR-1012 (5224.77) recoreded highest straw yield followed by BR-36 (4911.60) and PPR-2885 (4725.67).

Harvest index (%) :

Significant differences were noticed between moisture stress treatments, genotypes and their interactions. Due to dry spell from 47-67 DAS mean harvest index was significantly decreased. Among the genotypes BR-36 (42.35) recoreded highest straw yield followed by PPR-2773 (29.47) and PPR-1012 (29.29). Similar results were also reported by Mohapatra (1989).

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