Int.J.Curr.Microbiol.App.Sci (2020) *9*(6): 3496-3505

EXCELLENT PUBLISHERS

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 9 Number 6 (2020)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2020.906.411

Genetic Correlation between Various Traits in F_2 Populations Derived from Crosses Involving Specialty Varieties of Rabi Sorghum

S. Radhamma*, G. M. Sajjanar and M. B. Boranayaka

AICSIP, Regional Agricultural Research Station, Vijayapur- 586 101, India

**Corresponding author*

A B S T R A C T

Keywords

Rabi sorghum, Sorghum bicolor, Correlations, Genotypes, Yield and yield component traits, hurda, F_2 population, Value addition

Article Info

Accepted:
26 May 2020
Available Online:
10 June 2020

The genetic nature of character association for various traits was studied in Rabi sorghum using F_2 populations derived from four crosses of M 35-1 with specialty varieties *viz*., AKJ-1 (flaking), KMJ - 1 (popping), and SMJ-1 & RSJ-1 (hurda purpose). These varieties derived from landraces are recommended for cultivation in Northern Dry Zone of Karnataka. Grain yield per plant and fodder yield per plant were significantly and positively correlated with all the yield components studied plant height, panicle length, panicle breadth, panicle weight and 100 seed weight in the crosses M 35-1 x AKJ-1 and M 35-1 x KMJ-1. Positive and significant association was observed among these yield components in these crosses. Where as in the cross M 35-1 x RSJ-1 the association of grain yield per plant with all the above yield parameters was non-significant and in M 35-1 x SMJ-1 the association was significant only with plant height and panicle length. Days to 50% flowering was significantly negatively correlated with all the yield components in all the crosses except in the cross M 35-1 x KMJ-1. 100 seed weight was significantly positively associated with all other yield parameters in all the crosses except M 35-1 x KMJ-1 with non-significant and negative association with panicle length. In this cross, seed size in terms of 100 seed weight was significantly negatively correlated with popping expansion ratio and panicle length was positively correlated with popping quality traits studied *viz*., popping yield, popping expansion ratio and flake size. The results indicate the scope for isolating desirable segregants with high yield and earliness in the cross M 35-1 x AKJ-1. Where as in the cross M 35-1 x KMJ-1, panicle length can be used as indirect selection criteria for isolating desirable segregants. KMJ-1 was characterized by significantly higher panicle length compared to all other parents used in the study.

Introduction

Sorghum is one of the most important cereal crop in the world because of its adaptation to a wide range of ecological conditions, suitability for low input cultivation and diverse uses. Sorghum ranks third among the major food grain crops of our country. Besides a major source of staple food for humans, it serves as an important source of cattle feed and fodder. The greatest merit with jowar is that it has capacity to withstand drought.

In India, Maharashtra, Karnataka and Madhya Pradesh being the largest sorghum producing states. It is cultivated over an area of 5.2 million hectares with an annual production of 3.75 million tonnes and productivity of 720 kg/ha (Anon., 2018).

In Karnataka, it is cultivated in 1.09 million ha with an annual production of 1.26 million tonnes of grain with a productivity of 1162 kg/ha (https://aps.dac.gov.in/APY/Public_Report1.aspx; 2017-18). In India, sorghum is cultivated in both the *kharif* and *rabi* seasons. The *rabi* sorghum in Karnataka accounts for major share of total sorghum area (91.3%) under cultivation in the state and total production (87.5%).

Sorghum constitutes a source of calories, protein and minerals. Sorghum grain contains about 10-12% protein, 3%fat, and 70% carbohydrates. Progress has been made in developing high yielding varieties and hybrids with improved agronomic traits that resulted in excess production. Sorghum produced in India is consumed mostly in the form of roti (unleavened bread) and sankati (thick porridge). To some extent it is also eaten as parched and popped grain. Rabi sorghum (*post-rainy*) being the staple and nutritious cereal of Northern dry zone of Karnataka is characterized by excellent grain quality and tasty grains and fetches high price in the market.

During the course of rabi sorghum cultivation in northern belt of Karnataka, genotypes with specialty grain types have been evolved due to farmers selection for suitability for specific food purposes like *kadabina jola (*for steamed food 'kadabu'), *aralina jola* (for pops), *seethani jola* (for roasted tender grain), etc. (Sajjanar *et al.,* 2010; Patil *et al.,* 2010).

The genotypes have been identified for specific food purposes in these categories of speciality grain varieties *viz*., AKJ-1 for flaking (*kadabina jola*), KMJ-1 for popping (*aralina jola*) and SMJ-1 & RSJ-1 with sweet grains for hurda/seethani (*seethani jola*) (Sajjanar *et al.,* 2011a, Sajjanar *et al.,* 2011b, Biradar *et al.,* 2011a and Biradar *et al.,* 2011b). Studies on these genotypes showed that these genotypes are rich in grain antioxidants, and micronutrients (Keshavreddy *et al.*, 2010).

These special genotypes are with lower yielding ability and hence there is a need to improve yielding ability while maintaining their distinct grain quality traits. Knowledge of interrelationship between yield and yield attributing components enables the breeders to plan the breeding programme accordingly. The phenotype of a plant is the result of interaction of a large number of factors. Final yield is the sum of effect of several component factors. Correlation studies provide information on the nature and extent of association between any two pairs of metric characters. Grafius (1959) opined that there may not be any gene for yield as such but operates only through its components. Correlation studies will surely help to identify the character to make selections for higher yield with a view to determine the extent and nature of relationship among the yield contributing characters.

Materials and Methods

The experimental material consisted of F_2 populations derived from four crosses involving M 35-1, a popular rabi sorghum variety and four specialty varieties of rabi sorghum viz., AKJ-1 (flaking variety), KMJ-1 (popping variety), and SMJ-1 & RSJ-1 (hurda varieties). All the special varieties except RSJ-1 were released for cultivation in northern dry zone of Karnataka (The Gazette of India, 2018) for value addition in Rabi sorghum. All the varieties are with semi-compact panicle except RSJ-1 with compact panicle. KMJ-1 was characterized by long panicle with black glumes covering white seeds, and AKJ-1 with red glumes and seeds. Fresh F1 crosses *viz.*, M 35-1 x AKJ-1, M 35-1 x KMJ-1, M 35-1 x SMJ-1 and M 35-1 x RSJ-1 were made by hand emasculation and pollination, and F1s were advanced to F_2 by selfing during Rabi 2014-15 under AICSIP, RARS, Vijayapur. The Parents (P_1 and P_2) and F_1 were planted in two rows each, and F_2 populations in 20 rows each were planted in four meter length with a row spacing of 60 × 15 cm and in two replications during Rabi 2015-16 at AICSIP, Regional Agricultural Research Station, Vijayapur.

In both the replications, five plants in each of parents and F_1, all plants in F_2 generation were tagged for recording observations. Fertilizer applied was 8.7 g of urea per m^2 and 5.4 g of DAP per m^2. Thinning operation was carried out at 10 days after seedling emergence to ensure optimum number of plants. Observations were recorded on all tagged plants for all the four crosses for days to 50% flowering, plant height (cm), Panicle length (cm), panicle weight (g), 100 seed weight (g), grain yield per plant (g) and fodder yield per plant (g). In the cross M 35-1 x KMJ-1, additional observations were recorded for popping quality traits viz., popping yield (%), expansion ratio (ml/g) and flake size (ml) (ratio of popped grain volume to that of number of seeds per gram).

Results and Discussion

Yield

In the crosses M 35-1 × KMJ-1 and M 35-1 x AKJ-1, grain yield was found to be significantly and positively correlated with, plant height, panicle length, panicle breadth, panicle weight and 100 grain weight. In the cross M 35-1 × SMJ-1, significant and positive association for grain yield was found only with traits, plant height and panicle length. However, in the cross M 35-1 x RSJ-1, none of the component traits were significantly associated with grain yield. With respect to days to 50% flowering, none of the crosses showed significant association with grain yield. Regarding popping traits in the cross M 35-1 × KMJ-1, grain yield was found to be significantly and positively correlated with, popping yield and flake size. In this cross, grain yield per plant was significantly positively correlated with fodder yield per plant.

Mallinath *et al.,* (2004) reported in correlation studies that grain yield per plant was found to be significantly and positively associated with panicle weight and fodder yield per plant, Bohra *et al.,* (1986) for panicle length and Vijayakumar *et al.,* (2012) and Seetharam and Ganeshmurthy (2013) for panicle weight. Panicle breadth was significantly positively associated with grain yield per plant only in the crosses M 35-1 × KMJ-1 and M 35-1 x AKJ-1. The positive association between panicle breadth and grain yield per plant is justifiable as broad panicles will have more secondary branches.

In all the crosses except M 35-1 x SMJ-1 fodder yield per plant was found to be significantly and positively correlated with plant height, panicle length, panicle breadth, panicle weight and 100 grain weight. With grain yield per plant, fodder yield per plant was significantly and positively associated only in cross M 35-1 × KMJ-1.

Fodder yield per plant has direct effect on grain yield per plant (Mallinath *et al.,* 2004). In this cross, fodder yield per plant was found to be significantly and positively correlated with popping expansion ratio. In M 35-1 × AKJ-1 and M 35-1 × SMJ-1, fodder yield per plant was found to be significantly negatively correlated with days to 50% flowering. However, in the cross M 35-1 × SMJ-1, fodder yield per plant was found to be significantly and positively correlated with panicle breadth, panicle weight and 100 grain weight (Table 1–4).

Table.1 Correlation coefficients between yield and yield components in F_2 population of cross M35-1 × KMJ-1 in *rabi* sorghum

	Days to 50% flowering	Plant height	Panicle length	Panicle breadth	Panicle weight	100 seed weight	Grain yield per plant	Fodder yield per plant	Popping yield	Expansion ratio	Flake Size
Days to 50% flowering	1	0.172**	0.027	-0.043	-0.072	0.015	-0.014	0.004	-0.019	0.008	0.045
Plant height		1	0.486**	0.247**	0.476**	0.154**	0.434**	0.369**	0.025	0.001	0.071
Panicle length			1	0.271**	0.481**	-0.002	0.339**	0.246**	0.143**	0.097*	0.106*
Panicle breadth				1	0.424**	0.186**	0.312**	0.108*	0.016	-0.022	0.036
Panicle weight					1	0.265**	0.755**	0.212**	0.101*	0.036	0.155**
100 seed weight						1	0.375**	0.090*	0.027	-0.095*	0.069
Grain yield per plant							1	0.212**	0.101*	0.02	0.175**
Fodder yield per plant								1	0.068	0.026	0.095*
Popping yield									1	0.789**	0.754**
Expansion ratio										1	0.602**
Flake Size											1

** significant at the 0.01 level (2-tailed).
* significant at the 0.05 level (2-tailed).

Table.2 Correlation coefficients between yield and yield components in F_2 population of cross M35-1 × RSJ-1 in *rabi* sorghum

	Days to 50%0flowering	Plant height	Panicle length	Panicle breadth	Panicle weight	100 seed weight	Grain yield per plant	Fodder yield
Days to 50% flowering	1	-0.242**	-0.464**	-0.279**	-0.327**	-0.264**	0.098	-0.106
Plant height		1	0.760**	0.558**	0.643**	0.468**	0.116	0.285**
Panicle length			1	0.576**	0.670**	0.522**	0.032	0.245**
Panicle breadth				1	0.734**	0.579**	-0.042	0.316**
Panicle weight					1	0.636**	0.067	0.378**
100 seed weight						1	0.044	0.545**
Grain yield per plant							1	0.088
Fodder yield								1
****significant at the 0.01 level (2-tailed).**								
*** significant at the 0.05 level (2-tailed).**								

Table.3 Correlation coefficients between yield and yield components in F_2 population of cross M35-1 × AKJ-1 in *rabi* sorghum

	Days to 50%flowering	Plant height	Panicle length	Panicle breadth	Panicle weight	100 seed weight	Grain yield per plant	Fodder yield
Days to 50%flowering	1	-0.178**	-0.375**	-0.260**	-0.198**	-0.221**	-00.118	-0.136*
Plant height		1	0.604**	0.391**	0.447**	0.433**	0.453**	0.254**
Panicle length			1	0.564**	0.572**	0.460**	0.382**	0.278**
Panicle breadth				1	0.737**	0.499**	0.248**	0.182**
Panicle weight					1	0.719**	0.255**	0.168*
100 seed weight						1	0.258**	0.230**
Grain yield per plant							1	0.109
Fodder yield								1
**** significant at the 0.01 level.**								
*** significant at the 0.05 level**								

Table.4 Correlation coefficients between yield and yield components in F_2 population of cross M35-1 × SMJ-1 in *rabi* sorghum

	Days to 50% flowering	Plant height	Panicle length	Panicle breadth	Panicle weight	100 seed weight	Grain yield per plant	Fodder yield
Days to 50% flowering	1	-0.082	-0.203**	-0.258**	-0.377**	-0.360**	-0.051	-0.173**
Plant height		1	0.403**	0.157*	0.229**	0.260**	0.296**	0.084
Panicle length			1	0.231**	0.241**	0.095	0.143*	0.100
Panicle breadth				1	1.633**	1.438**	0.056	0.198**
Panicle weight					1	0.695**	-0.052	0.301**
100 seed weight						1	0.016	0.314**
Grain yield per plant							1	0.038
Fodder yield								1

****significant at the 0.01 level (2-tailed).**

*** significant at the 0.05 level (2-tailed).**

Seed size

In all the crosses, 100 seed weight was found to be significantly and positively correlated with plant height, panicle breadth, panicle weight and fodder yield per plant. It was positively and significantly associated with grain yield in crosses M 35-1 × KMJ-1 and M 35-1 × AKJ-1. It was positively and significantly associated with panicle length in crosses M35-1 × RSJ-1 and M 35-1 × AKJ-1. In the cross M 35-1 x KMJ-1, 100 seed weight was found to be significantly and negatively correlated with popping expansion ratio. With days to 50% flowering, 100 seed weight was found to be significantly and negatively correlated in all the crosses except in M 35-1 x KMJ-1 which recorded non-significant association. Results of 100 seed weight showing non significant and positive correlation with grain yield per plant were obtained by Bakheti (1990) and Godbharle *et al.,* (2010).

Flowering time

In the crosses M 35-1 × RSJ-1, M 35-1 × AKJ-1 and M 35-1 × SMJ-1 days to 50% flowering was found to be significantly and negatively correlated with panicle length, panicle breadth, panicle weight and 100 seed weight. In the crosses, M 35-1 × AKJ-1 and M 35-1 × SMJ-1, days to 50% flowering was found to be significantly and negatively correlated with fodder yield per plant. In the cross M 35-1 × KMJ-1, days to 50% flowering was found to be significantly and positively correlated with plant height. Whereas it was significantly negatively correlated with plant height in other crosses M 35-1 x RSJ-1 and M 35-1 x AKJ-1. Days to 50% flowering was significantly and positively correlated with grain yield per plant, were reported by Liang *et al.,* (1969), Crook and Casady (1974), Sindagi *et al.,* (1970), Patel *et al.,* (1980b), Jadhav *et al.,* (1994), Veerabadhiran *et al.,* (2001), Prabhakar (2001), Rajkumar *et al.,* (2007), and Seetharam and and Ganesamurthy (2013).

Popping quality traits

All the popping quality traits *viz*., popping yield (%), expansion ratio and flake size were positively significantly associated with panicle length in the cross M 35-1 x KMJ-1. Significant positive association was noticed between popping traits popping yield (%), expansion ratio and flake size. In a study by Mallinath *et al.,* (2004), it was also reported that popping yield was positively correlated with the expansion ratio and flake size, and the positive correlation observed among flake size and expansion ratio. In the present study signficant negative association was found between popping expansion ratio and 100 seed weight. In a study conducted by Jele *et al.,* (2014) to determine relationships among quality traits in popcorn hybrids, it was also reported a significant negative relationship between flake volume and kernel size; while the number of unpopped kernels was positively correlated with kernel size ($p \leq 0.05$). In the present study popping yield and flake size were significantly positively associated with panicle weight and grain yield per plant. Panicle length was significantly and positively associated with panicle breadth, panicle weight, grain yield per plant and fodder yield per plant. Therefore, panicle length may be used as indirect selection criteria in isolating desired genotypes with high yield and popping traits.

M 35-1, a popular variety of Rabi sorghum, derived from landrace and occupies major area since more than five decades. The specialty varieties are derived from landraces that are evolved in the Rabi sorghum belt along with many relatives of *Maldandi*. It is challenging to isolate high yielding lines with specialty grain traits maintained in the crosses of M 35-1 with these specialty varieties. The association study indicated the scope for isolation of segregants with high yield and yield components in the crosses M 35-1 x AKJ-1 (flaking variety) and M 35-1 x KMJ-1 (popping variety) and early with high yield in the cross M 35-1 x AKJ-1. However, it needs to be studied the association of yield with flaking quality traits in M 35-1 x AKJ-1. The association of popping quality traits studied in the cross M 35-1 x KMJ-1 indicated the significant positive association of grain yield and panicle length with popping quality traits (popping yield, popping expansion ratio and flake size), significant positive association between panicle length, grain yield and fodder yield. Therefore, panicle length in this cross can be used as indirect selection criteria to isolate desired lines of pop sorghum. The significant negative association of 100 seed weight with popping expansion ration indicated that smaller the seed size the greater popping expansion ratio. Regarding hurda varieties SMJ-1 and RSJ-1, the non-significant association of grain yield with number of yield components, indicating less scope for isolating high yielding genotypes in the crosses M 35-1 x SMJ-1 and M 35-1 x RSJ-1.

Acknowledgements

Authors are thankful to ICAR for financial support under AICRP (Sorghum).

References

Anonymous., 2018, Selected state wise Area, Production and Productivity of Jowar in India.

Bakheti, B.R.1990., Variability and correlations in grain sorghum genotypes (Sorghum bicolor (L.) Moench) under drought condition at different stages of growth. Crop Science, 164: 355-360.

Biradar BD., Sajjanar GM and Hemalatha S., 2011a, A special Rabi sorghum variety, AKJ-1 identified for flaking on commercial scale. In proceedings of NAIP National Symposium on "Recapturing nutritious Millets for Health and management of diseases" UAS, Dharwad, Dec. 16-17, 2011. p64.

Biradar BD., Sajjanar GM and Hemalatha S., 2011b, A sweet grain variety of Rabi sorghum, SMJ-1 identified for tender grain processing. In proceedings of NAIP National Symposium on "Recapturing nutritious Millets for Health and management of diseases" UAS, Dharwad, Dec. 16-17, 2011. p65.

Bohra, P., Phal, P.S. and Allah Rang, 1986., Association analysis for yield and quality traits in sorghum. J. Crop Improvement., 12: 89-93

Crook, W. J. and Casady, A. J., 1974, Heritability and interrelationships of grain protein content with other agronomic traits of sorghum. *Crop Sci.*, 14: 622-624.

Godbharle, A.R., More, A.W., and Ambekar, S.S., 2010, Genetic variability and correlation studies in elite B and R lines in Kharif sorghum. Electronic J. of Pl. Breed. 1: 989-993

Grafius, J. E., 1959, Heterosis in barley. *Agron. J.*, 51: 551-554.

https://www.indiastat.com.

Jadhav, J. B., Shweale, M. R., Patil, J. D. and Patil, C. B., 1994, Heat energy utilization by different dry land winter sorghum cultivars in semi arid tracts of Maharashtra. *Madras Agric. J.*, 81: 407-408.

Jele, Derera, Siwela., 2014, Assesment of popping ability of new tropical pop corn hybrids, AJCS 8(6) :831-839.

Keshav Reddy, A., Sajjanar, G. M., Biradar, B. D., Hemalatha, S. and Salimath, P. M., 2010, Evaluation of *rabi* sorghum genotypes for grain micronutrients. In: *Nation. Seminar on Millets*. Res. and devp. in Millets: Present status and future strategies, NIRD, Hyderabad, Directorate Sorghum Res. (DSR), Rajendranagar, Hyderabad, India, November 12., 81(4): p. 103.

Liang, G. H. L., Overlx, C. B. and Casady, A. J., 1969, Interrelations among agronomic characters in grain sorghum (*Sorghum* *bicolor* (L.) Moench). *Crop Sci*., 9: 299-302.

Mallinath, V., Biradar, B.D., Chittapur, B.M., Salimath, P.M., Nirmala Yenagi and Patil, S.S., 2004, Variability and correlation studies in pop sorghum. *Karnataka J. Agri. Sci.*, 17 (3):(463-467).

Patel, R. H., Desai, K. B., Raja, K. R. V. and Parikh, R. K., 1980b, Estimation of heritability and other genetic parameters in an F_2 population of sorghum. *Sorghum Newsltr.*, 23: 22-23.

Patil, B. P., Sajjanar, G. M., Biradar, B. D., Patil, H. B. and Devarnavadagi, S. B., 2010, Technology of hurda production by microwave oven. *J. Dairy. Foods H. S.*, 29 (3/4) : 232 – 236.

Prabhakar, 2001, Variability, heritability, genetic advance and character association in *rabi* sorghum. *J. Maharashtra Agric. Univ*., 26: 188-189.

Rajkumar., Fakrudin, B. and Kuruvinashetti, M. S., 2007, Variability and correlation studies for charcoal rot (stalk rot) and yield components in recombinant inbred lines of sorghum. *Indian J. Genet. Pl. Breed*., 67(2).

Sajjanar GM, Biradar BD and Prema Patil, 2010, Sorghum landrace variety for Hurda, *Jowar Samachar*, 7 (1): 6-8

Sajjanar, G.M., Biradar, B.D., and Hemalatha, S., 2011a, RSJ-1, A Rabi Sorghum Variety Suitable for preparation of Hurda. In proceedings of NAIP National Symposium on "Recapturing nutritious Millets for Health and management of diseases" UAS, Dharwad, Dec. 16-17, 2011. p67.

Sajjanar, G.M., Biradar, B.D., and Hemalatha, S., 2011b, KMJ-1, A Rabi Sorghum Variety Suitable for popping. In proceedings of NAIP National Symposium on "Recapturing nutritious Millets for Health and management of diseases" UAS, Dharwad, Dec. 16-17, 2011. p68

Seetharam, K. and Ganesamurthy, K. 2013, Characterization of sorghum genotypes for yield and other agronomic traits through genetic variability and diversity analysis. Electronic J. of Pl. Breed., 4: 1073-1079.

Sindagi Swarup, V. and Singh, D., 1970, Variation and heritability of some quantitative characters in F_2 progenies of inter varietal crosses of sorghum. *Indian J. Genet.*, 30: 660-664.

Some of these varieties were subjected for pure line selection and evaluation, tested for nutrition and suitability for various food products and were released for cultivation in northern dry zone of Karnataka (The Gazette of India, 2018).

The Gazette of India, 2018, The Gazette of India: Extrordinary, No. 1246, Notification Published by by Ministry of Agriculture and Farmers Welfare, New Delhi dated 27 March 2018.

Veerabadhiran, P. and Kennedy, V. J. F., 2001, Correlation and path analysis studies in selected germplasms of sorghum. *Madras Agric. J.*, 88 (4/6): 309-310.

Vijayakumar, N., Reddy, C.V.C.M and Reddy, P.V.R.M. 2012, Study on character association in rabi sorghum (*Sorghum bicolor* L. Moench). Pl. Archives., 12: 1049-1051.

How to cite this article:

Radhamma, S., G. M. Sajjanar and Boranayaka, M. B. 2020. Genetic Correlation between Various Traits in F_2 Populations Derived from Crosses Involving Specialty Varieties of Rabi Sorghum. *Int.J.Curr.Microbiol.App.Sci.* 9(06): 3496-3505.
doi: https://doi.org/10.20546/ijcmas.2020.906.411