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GENERATION OF FAVOURABLE ASSOCIATIONS THROUGH BIPARENTAL MATINGS IN OATS

C. KISHOR, R. S. PARODA AND D. S. JATASRA

Department of Plant Breeding
Haryana Agricultural University, Hisar 125004

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ABSTRACT

Association pattern has been studied in biparental matings (NC I, NC II and triple testcross) and F_2 generation of a divergent cross of forage oats. Leaf number, tiller number, green leaf weight, dry leaf weight, green stem weight, and dry stem weight had strong positive association with each other and all these traits were positively correlated with both green fodder and dry matter yields in all the populations investigated. Protein content and digestibility (IVDMD) did not show any relationship with yield and its components except in triple testcross, where positive associations of leaf number and green leaf weight with both the quality traits are of interest to oat breeders. The magnitude as well as direction of correlations changed in the biparental progenies. The antagonistic interrelationships of days to flower with height, green stem weight, dry stem weight, green fodder yield, and dry matter yield in F_2 generation were not observed in the populations of three mating designs presumably due to the breakage of undesirable linkage.

Key words: *Avena sativa* L., biparental matings, forage yield, correlation, quality attributes.

Biparental mating, in addition to mopping up of additive genetic variance, also offers the possibility of breaking undesirable linkages among yield attributes through intermating. These matings have been used to some extent for the improvement of quantitative traits in self-pollinated crops. However, such studies are lacking in oats and further studies are needed to examine the utility of biparental matings in the early segregating generations from the point of view of creation of desirable genetic variability, specially by breaking the undesirable linkages. Accordingly, the present investigation has been undertaken to compare the association pattern of F_2 generation with that of biparental matings in forage oats (*Avena sativa* L.).

MATERIALS AND METHODS

From a divergent cross of oats (OS7 × Flammings gold), biparental crosses were made in North Carolina design I (NC I), North Carolina design II (NC II) and triple testcross (TTC) during 1980–81 at the Haryana Agricultural University Research Farm, Hisar. In NC I, 15 out of the 60 randomly selected F_2 plants were used as males and 45 plants as females resulting in 45 biparental crosses which were then grouped in five sets with three males in each set. For NC II, 30 randomly selected F_2 plants were grouped into five sets. In each set, all three male plants were crossed with each female, producing nine crosses in each set. For TTC, 15 plants randomly selected from F_2 were backcrossed as male parent to both the parents and their F_1 to obtain L_1i, L_2i, and L_3i families. This resulted in 45 crosses.

The genetic materials for the three mating designs and of F_2 generation were grown separately in four randomized block designs with three replications in contiguous fields during winter 1981–82. Sowing was done in single-row plots of 3 m length with 30 × 20 cm spacing. Five competitive plants were selected at random in each replication from 45 progenies of each cross in all three mating designs to record data on 12 quantitative traits (Table 1). The data averaged over five plants were analysed. In F_2 generation, data were recorded on 45 plants per replication on 10 characters. The correlation coefficients for various populations were worked out by the standard method.

RESULTS AND DISCUSSION

The correlation coefficients between various characters in NC I and NC II populations are presented in Table 1. A perusal of this table reveals that tiller number, leaf number, green and dry leaf weight, and green and dry stem weight were positively and significantly associated with green fodder as well as dry matter yield in both populations. These yield components had strong positive associations with each other also in NC I and NC II populations. Similar pattern of association was observed in the TTC population except that tiller number, leaf number, and green leaf weight had nonsignificant positive correlations with dry stem weight. Similar results from varietal collections of oats were reported earlier [1–5].

Flowering time was negatively correlated in F_2 and TTC (Table 1). However, no such association was observed in NC I and NC II populations. Obviously, this antagonistic association was broken in the NC populations. Ross [6], Petr and Frey [7], and Sampson [8] reported that heading date and plant height were positively associated in oats. Days to flower recorded positive correlation with dry leaf weight in TTC. In F_2 generation, green and dry stem weight as well as green fodder and dry matter yield showed negative association with days to flower, but positive with plant height. Plant height also indicated positive relationship with dry stem weight and dry fodder yield in TTC, and with green and dry stem weight, and dry matter yield in NC I.

An apparent lack of associations was observed for quality traits in NC I, while only one antagonistic correlation of IVDMD with plant height was recorded in NC II (Table 1). In TTC, IVDMD showed strong negative association with plant height, dry stem weight and dry matter yield. On the other hand, IVDMD showed positive relationship with leaf number and green leaf weight (Table 1).

Crude protein was positively correlated with tiller number, leaf number, green leaf and dry leaf weight.

Table 1. Phenotypic correlations between various characters

Character	Days to flower	Plant height	Tiller number	Leaf number	Green leaf weight	Dry leaf weight	Green stem weight	Dry stem weight	Green fodder yield	Dry matter yield	Crude protein	IVDMD
NC I (upper, right) and NC II (lower, left)												
Days to flower	—	0.04	−0.17	0.05	0.20	0.25	0.07	−0.03	0.11	0.02	−0.11	0.16
Plant height	−0.01	—	−0.07	−0.04	0.10	0.21	0.31*	0.46**	0.27	0.44**	0.01	−0.29
Tiller number	0.02	−0.15	—	0.78**	0.43**	0.49**	0.44**	0.42**	0.45**	0.46**	0.09	−0.10
Leaf number	0.01	−0.15	0.89**	—	0.58**	0.73**	0.55**	0.51**	0.59**	0.58**	0.03	0.05
Green leaf weight	−0.17	−0.22	0.53**	0.63**	—	0.85**	0.78**	0.40**	0.87**	0.50**	0.02	−0.10
Dry leaf weight	0.15	0.10	0.67**	0.73**	0.74**	—	0.83**	0.61**	0.87**	0.72**	0.06	−0.08
Green stem weight	−0.08	−0.03	0.62**	0.69**	0.83**	0.86**	—	0.82**	0.99**	0.87**	0.11	−0.18
Dry stem weight	0.15	0.19	0.64**	0.60**	0.30*	0.74**	0.72**	—	0.75**	0.99**	0.12	−0.28
Green fodder yield	−0.10	−0.08	0.62**	0.70**	0.90**	0.86**	0.99**	0.63**	—	0.82**	0.09	−0.17
Dry matter yield	0.15	0.18	0.67**	0.64**	0.39**	0.81**	0.77**	0.99**	0.70**	—	0.12	−0.26
Crude protein	−0.03	−0.20	0.16	0.15	0.23	0.02	0.04	−0.12	0.09	−0.10	—	0.05
IVDMD	−0.23	−0.33*	−0.05	−0.08	0.09	−0.18	−0.08	−0.28	−0.04	−0.27	0.22	—
Triple testcross (upper, right) and F_2 generation (lower, left)												
Days to flower	—	−0.40**	−0.04	0.08	−0.16	0.30*	−0.11	−0.01	−0.13	0.06	0.01	0.07
Plant height	−0.55**	—	−0.06	−0.15	−0.04	−0.05	0.29	0.48**	0.21	0.41**	−0.09	−0.39**
Tiller number	−0.07	0.05	—	0.86**	0.70**	0.61**	0.57**	0.27	0.63**	0.35**	0.39*	0.17
Leaf number	−0.08	0.09	0.93**	—	0.82**	0.75**	0.62**	0.20	0.71**	0.32*	0.43**	0.31*
Green leaf weight	−0.17	0.22	0.77**	0.87**	—	0.72**	0.76**	0.24	0.86**	0.35*	0.33*	0.36*
Dry leaf weight	−0.07	0.16	0.74**	0.81**	0.90**	—	0.81**	0.58**	0.82**	0.70**	0.34*	0.08
Green stem weight	−0.39**	0.48**	0.53**	0.52**	0.70**	0.65**	—	0.77**	0.98**	0.83**	0.25	−0.09
Dry stem weight	−0.43**	0.50**	0.58**	0.56**	0.69**	0.65**	0.96**	—	0.66**	0.99**	0.09	−0.49**
Green fodder yield	−0.37*	0.46**	0.60**	0.61**	0.78**	0.73**	0.99**	0.95**	—	0.74**	0.28	−0.03
Dry matter yield	−0.39**	0.47**	0.64**	0.63**	0.76**	0.74**	0.96**	0.99**	0.97**	—	0.14	−0.41**
Crude protein	—	—	—	—	—	—	—	—	—	—	—	0.18

*, **Significant at P = 0.05 and P = 0.01, respectively.

A critical examination of correlations (Table 1) indicates that intermating in F_2 population following all the three mating designs changed the trend of some character associations. In F_2 generation, days to flower exhibited strong negative associations with height, green stem weight, green fodder and dry matter yield. The direction as well as magnitude of associations changed after intermating in three designs. Days to flower showed significant negative correlation with plant height in TTC progenies. Even the positive association of days to flower with dry leaf weight appeared in triple testcross. Days to flower did not show any relationship with other characters in the progenies of NC I and NC II. Obviously, the undesirable associations of days to flower in F_2 generation were thoroughly changed as a result of biparental matings.

Desirable associations of plant height with green and dry stem weight, and dry matter yield were observed in NC I for all the characters except green fodder yield. Supporting evidence on such breakage of linkages and release of desirable variability through intermating has been provided by studies in cotton [9] and wheat [10, 11]. It is, therefore, evident that the changes in correlations brought about through intermating would play a useful role in the release of new genetic variability. However, much would depend on the kind of linkages involved, i.e. coupling or repulsion.

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