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Correlation Among Different Characters of Plum as Affected by Various Methods of Thinning

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Abstract Thinning is a practice of removal of a portion of crop in early developing stage and is commonly practiced in fruit crops with a view to prevent over cropping, alternate bearing and to improve the fruit quality. To measure the mutual relationship between different characters and to determine the component traits on which selection can be relied, a correlation study was conducted on twenty four year old trees of plum cv Santarosa. The experiment consisted of eight treatments replicated thrice (chemical thinning with ethephon @ 50, 100 and 150 ppm and hand thinning (10%, 20% and 30%) were done at full bloom stage i.e. when 90% flower buds had opened and two control featuring, one having distilled water thinning and in second trees were unsprayed and unthinned) in randomized block design was laid out. Observations were recorded on 17 characters comprised all fruiting, yield, physical and chemical characters. Correlation study performed depicts that fruit length (0.8806), fruit diameter (0.8391) and fruit weight (0.8747) was positively correlated with the yield and yield contributing characters. Acidity was positively and highly significantly correlated with initial fruit set .(8234) and yield (0.7212). Fruits from heavy cropping trees were smaller, firmer and had a lower TSS content, which indicates that a moderate decrease significantly affect the fruit quality.

Keywords Plum, Correlation, Thinning, Ethephon, Santarosa.

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Introduction

Flower thinning is very effective method of reducing a number of blossoms. It depends on weather and variety. Flower thinning conserves photosynthetic reserves and improve fruit size and yield [1, 2]. Plum is an important stone fruit crop of temperate region, stands next to peach in economic importance and is used both as fresh and in preserved form. Area under plum orchards in Jammu and Kashmir is 4870 hectares with an annual production of 7,937 metric tonnes [3]. In Jammu and Kashmir, still Santa Rosa is a leading commercial cultivar of Japanese plum known for its fair quality, aroma and characteristic flavor. It is self fruitful and is used as a pollinizer for other cultivars but has got a tendency towards overbearing which leads to limb breakage that invariably makes way to silver leaf disease. This further leads to a poor fruit quality and reduced fruit size making it unable to meet the market requirements for better remuneration. To overcome the problems associated with overbear-

Table 1. Correlation coefficients among various characters recorded in plum cv Santa Rosa. **Significant at 1%, *Significant at 5%. 1. Initial fruit set (%), 2. Fruit retention at harvest (%), 3. Leaf/fruit ratio, 4. Fruit maturity (days after full bloom), 5. Yield (kg/tree), 6. Fruit length (cm), 7. Fruit diameter (cm), 8. Fruit weight (g), 9. Stone weight (g), 10. Pulp (%), 11. Pulp/stone ratio, 12. Acidity (%), 13. TSS/acid ratio, 14. Fruit volume (cm^3), 15. Fruit firmness (kg/cm^2),16. Anthocyanins (mg/100 g), 17. TSS (^{0}B).

Characters	1	2	3	4	5	6	7	8	9
1	1	0.9477**	-0.8636**	0.7421*	0.8924**	-0.9062**	-0.9266**	-0.9522**	-0.7368*
2		1	-0.9396**	0.6860*	0.8247**	-0.8581**	-0.8464**	-0.8609**	-0.7427**
3			1	-0.6420*	-0.7581*	0.7354*	0.7467*	0.7417*	0.6877*
4				1	0.5969	-0.5164	-0.6432	-0.6969*	-0.4626
5					1	0.8806**	0.8391**	0.8747**	-0.6267
6						1	0.8759**	0.9164**	0.7802*
7							1	0.9208**	0.7668*
8								1	0.7447*
9									1
10									
11									
12									
13									
14									
15									
16									
17									.

Table 1. Continued.

Characters	10	11	12	13	14	15	16	17
1	-0.9440**	-0.9657**	0.8234**	-0.8591**	-0.9224**	0.0969	-0.6621	-0.8762**
2	-0.8358**	-0.8638**	0.7816*	-0.8136**	-0.8422**	0.1168	-0.5924	-0.8222**
3	0.7142*	0.2450	-0.6747*	0.6917*	0.7597*	-0.0961	0.4951	0.6974*
4	-0.6853*	-0.7008*	0.8766**	-0.8794**	-0.5704	0.5622	-0.8476**	-0.5764
5	-0.9184**	-0.8900**	0.7212**	-0.7430**	-0.8628**	-0.7119**	-0.5156	0.7577*
6	0.9227**	0.9124**	-0.6300	0.6869*	-0.9130**	0.1202	0.4413	0.7285*
7	0.8988**	0.9092**	-0.6938*	0.7293*	0.9432**	0.1268	0.5053	0.7672*
8	0.9464**	0.9823**	-0.7979*	0.8291**	0.9141**	-0.7743**	-0.6375	0.8457**
9	0.7005*	0.7167*	-0.4808	0.5375	0.7614*	0.1488	0.3229	0.5792
10	1	0.9642**	-0.7697*	0.8174**	0.9145**	-0.0602	0.6319	0.8427**
11		1	-0.7993**	0.8341**	0.9197**	-0.0913	0.6671*	0.8618**
12			1	-0.9677**	-0.6422	0.5435	-0.8573**	-0.9545**
13				1	0.6705*	-0.5015	0.9141**	0.9793**
14					1	0.1799	0.4355	0.7135*
15						1	-0.6821*	-0.4501
16							1	0.8866**
17								1

ing, thinning (hand and chemical) is the only means and as such the present study was conducted with hand and chemicals. The yield is dependent on many component characters and complexity of yield makes total correlation insufficient to explain the true association between the characters. Before going to breeding program it is essential to know the importance and inter association of various components and their association with yield. The correlation coefficient analysis measures the mutual relationship between various characters and it determines the component traits on which selection can be relied upon the effect of improvement.

Materials and Methods

Experimental material and site

Twenty four year old trees of plum cv Santa Rosa which received uniform cultural operations at Divi-

sion of Fruit Science, SKUAST-Kashmir, Shalimar campus were selected for study. The experimental site is situated at an altitude of 1585 m above mean sea level and between 34 ^{0}N latitude and 74.9 ^{0}E longitude. The experiment consisted of eight treatments replicated thrice with a single plot size in a randomized block design.

Treatments

Chemical thinning with ethephon concentration at 50, 100 and 150 ppm and handthinning (10%, 20% and 30%) were done at full blood stage i.e. when 90% of the flower buds had opened. Two control featuring one having distilled water thinning and in second trees were unsprayed and unthinned. Randomly selected trees were sprayed with water and ethephon to slightly runoff condition at full bloom.

Observations recorded

Observations were recorded on initial fruit set (%), fruit retention at harvest (%), leaf/fruit ratio, fruit maturity (days after full bloom), yield (kg/tree), fruit length (cm), fruit diameter (cm), fruit weight (g), stone weight (g), pulp (%), pulp/stone ratio, acidity (%), TSS/acid ratio, fruit volume (cm^3), fruit firmness (kg/cm^2), anthocyanins (mg/100 g) and TSS (^{0}B). Before thinning, flowers were counted on each experimental tree. For all the physical characters 10 randomly selected fruits were taken and observations were recorded. Chemical analysis of the fruits under each treatment was done as per the method [4].

Statistical analysis

Observations were statistically analyzed and were calculated [5]. Correlation coefficients were computed using the standard method [6].

Results and Discussion

High level of genotypic influence and lesser environmental effect on the characters expression was evident from the higher values of genotypic correlation coefficients (Table 1) compared to phenotypic correlation coefficients. At genotypic level initial fruit set was positively and highly correlated with fruit retention at harvest (0.9477) which shows that at harvesting time the fruit retention is directly dependent on the initial setting of the fruits. While working on variability studies in peach for productivity a strong and significant correlation was observed between initial fruit set and final fruit set [7, 8]. Leaf/fruit ratio is highly but negatively correlated with initial fruit set (0.8636) and fruit retention at harvest (-0.9396). Fruit maturity was positively correlated with initial fruit set (0.7421) and fruit retention at harvest (0.6860), however negatively correlated with leaf/fruit ratio (-06420).

Highly significant and positive correlation was observed for yield with initial fruit set (0.8924) and fruit retention at harvest (0.8247), however yield has negative correlation with leaf/fruit ratio (-0.7581). Yield per plant was also significantly and positively associated in apple with days after full bloom and final fruit before harvesting [9]. A significant correlation was found between initial and final fruit set of peach along with and yield, as well as between final fruit set and yield [7, 8].

Negative but highly significant correlation was showed by fruit length and fruit diameter for initial fruit set (-0.9062 and -0.9266) and fruit retention at harvest (-0.8581 and -0.8464). Leaf/fruit ratio (0.7354) showed positive correlation with fruit length (0.7354) showed positive correlation with fruit length (0.7354) and fruit diameter (0.7467). Both fruit length and fruit breadth was highly significantly and positively correlated with yield (0.8806 and 0.8391). Fruit diameter showed highly positive correlation with fruit length (0.8759). Positive and significant association of apple fruit weight with fruit length and breadth and fruit length with fruit breadth [9, 10]. Fruit and stone weight was highly but negatively correlated with initial fruit set (-0.9522 and -0.7368), fruit retention at harvest (-0.8609 and -0.7427). Positive correlation was observed for leaf/fruit ratio fruit weight (0.7417) and stone weight (0.6877). Highly significant and positive correlation was observed for fruit weight with yield (0.8747), fruit length (0.9164) and fruit diameter (0.9208).

Acidity showed positive and highly significant correlation with initial fruit set (0.8234), fruit maturity

(0.8766) and yield (0.7212), however with respect to pulp/stone ratio (-0.7993) highly significant but negatively correlation was recorded. Simple negative correlation was noticed between acidity and leaf/fruit ratio (-0.6747), fruit weight (-0.7979) and pulp percentage (-0.7697). Titratable acidity was highly correlated with cropping load i.e. yield, probably because of differences in acid metabolism between heavy yield trees and standard yield tress, however, negatively correlated with fruit weight [11].

Acidity (-0.9677), yield (-0.7430), fruit maturity (-0.8794), fruit retention at harvest (-0.8136) and initial fruit set (-0.8591) shows highly significant and negative correlation with TSS/acid ratio. Positive and highly significant correlation was noticed for pulp/stone ratio (0.8341), pulp percentage (0.8174) and fruit weight (0.8291) with TSS/acid ratio. Leaf/fruit ratio (0.6917), fruit length (0.6869) and fruit diameter (0.7293) was positively correlated with TSS/acid ratio. Fruit volume was positively and highly significantly correlated with fruit length (0.9130), fruit diameter (0.9432), fruit weight (0.9141), pulp percentage (0.9145) and pulp/stone ratio (0.9197), however simple positive correlation was observed for leaf/fruit ratio (0.7597), stone weight (0.7614) and TSS/acid ratio (0.6705). Initial fruit set (-0.9224), fruit retention at harvest (-0.8422) shows highly significant and negative correlation with fruit volume.

Highly significant and negatively correlation was recorded with flesh firmness for yield (-0.7119) and fruit weight (-0.7743). Flesh firmness is negatively correlated with mean fruit weight and crop load level in 'Cox's Orange Pippin' apple [12, 13].

Fruit maturity (-0.8476) and acidity (-0.8573) was negatively and highly significantly correlated with anthocyanin contents, however anthocyanin shows positive correlation with pulp/stone ratio (0.6617) and TSS/acid ratio (0.9141). Total soluble solids was positively and highly significantly correlated with anthocynanin (0.8866), TSS/acid ratio (0.9793), pulp/stone ratio (0.8618), pulp percentage (0.8427) and fruit weight (0.8457), and also showed simple positive correlation was noticed for leaf/fruit ratio (0.6974), fruit length (0.7285), fruit diameter (0.7672) and fruit volume (0.7135), however, negatively and highly significant correlation was observed for acidity (-0.9545), fruit retention at harvest (-0.8222) and initial fruit set (-0.8762). TSS content was highly correlated with flesh firmness and yield [14]. Positive correlation was also observed between TSS and as well as fruit size in some Iranian plums genotypes [15].

Conclusion

It is concluded from the present study that thinning usually increases fruit size more by reducing the number of the smallest fruits than by increasing the size of the remaining fruits. Total Soluble Solid content was lower whereas, titratable acidity flesh firmness were higher with heavy cropping trees than with standard cropping trees. Fruit quality parameters were best and fruit size was the largest in thinned plants.

References

1. Coneva ED, Cline JA (2006) Blossom thinners reduce crop load and increase fruit size and quality of peaches. Hort Sci 41 : 1253—1258.
2. Fallahi E, Rom CR, Fallahi B (2003) Influence of organic blossom thinners on fruit set and quality in apple, peaches and plum. Hort Sci 38 : 690.
3. Anonymous (2014) Statement showing area and production of different fruits in J & K state. Department of Horticulture. J & K Govt. Srinagar, pp 1—2.
4. Rangana S (1986) Handbook and analysis and quality control for fruits and vegetable products. Tata McGraw-Hill Publ Co Ltd, New Delhi.
5. Snedecor GE, Cochran WG (1989) Statistical Methods. Iowa state Univ Press, Ames, Iowa, pp 177.
6. Al-Jibouri HA, Miller PA, Robinson HV (1958) Genotypic and environmental variances and co-variances in a upland cotton cross of inter-specific origin. Agron J 50 : 633—636.
7. Rakonjac V (2005) Genetic parameters of the major pomological properties of peach. Vocarstvo 39 : 3—12.
8. Milatovic D, Nikolic D, Durovic D (2010) Variability, heritability and correlations of some factors affecting productivity in peach. Hort Sci (Prague) 37 : 79—87.
9. Barua U, Sharma RK (2004) Correlation and path analysis studies in apple. Ind J Hort 61 : 18—23.
10. Das SC, Dinesh MR (2004) Genetic variability, heritability and genetic advance in papaya (*Carica papaya* L.) cultivars. Ind J Hort 61 : 23—28.
11. Szot I (2010) Flower and fruit thinning effects on the development and quality of Sampion apple fruits. J Fruit and Ornam Pl Res 18 : 129—138.
12. Treder W (2008) Relationship between yield, crop den sity coefficient and average fruit weight of Gala apple. J Fruit and Ornam Pl Res 16 : 53—63.

13. Wocior S (2008) Influence of hand thinning of flowers and fruits on yielding and fruit quality of apple cultivar Szampion. Acta Agrobot 61 : 141—146.
14. Salvador FR de, Fisichella M, Fontanari M (2006) Correlations between fruit size and fruit quality in apple trees with high and standard crop load levels. J Fruit and Ornam Pl Res 14 : 113—122.
15. Aazami MA, Jalili E (2011) Study of genetic diversity in some Iranian plum genotypes based on morphological criteria. Bulgarian J Agric Sci 17 : 424—428.