Bulgarian Journal of Agricultural Science, 18 (No 4) 2012, 578-582
Agricultural Academy

EFFECT OF APPLICATION OF BASIC (REJUVENATING) PRUNING ON PRODUCTION TRAITS OF OIL – BEARING ROSE

N. KOVATCHEVA and N. NEDKOV
Institute for Roses, Aromatic and Medicinal Plants, BG – 6100 Kazanlak, Bulgaria

Abstract

KOVATCHEVA, N. and N. NEDKOV, 2012. Effect of application of basic (rejuvenating) pruning on production traits of oil – bearing rose. *Bulg. J. Agric. Sci.,* 18: 578-582

Oil-bearing rose (*Rosa damascena* Mill. *F. trigintipetala* Dieck.) is a perennial crop, which is grown for 20-25, at the same place. After 8-10 year, rose bushes lose its active growth and gradually reduce the flower yields. To stop this aging, in rose-production practice is done periodically rejuvenate (pruning) of the rose bushes. There is limited information available on factors controlling yield and its components after application of basic (rejuvenating) pruning the bushes of oil-bearing roses. This study presents the results of the impact of 11 morphological characteristics on the flower yield in 4 varieties of roses. The effect on the variety is different. With the best productive capacity differs variety Eleina. Of the studied signs, greatest variation are number of flowering and vegetative twigs per plant, 68.49% and 66.97%, at least - the dimensions of flower. There was a strong positive correlation between the flower yield per plant and weight of a flower (0.519). The developed regression models can predict yields. PC analysis reduced the original characteristics in the experiment of 3 main components, explaining 72.48% of the total variation.

Key words: Rosa damascena, pruning, correlation, regression, PC analysis

Introduction

The oil-bearing rose is a major crop in our country. After definition technology, from the raw material is received rose oil, rose water, rose concrete, which are used in cosmetics, pharmaceuticals, food industry. Currently, the rose plantation in our country are 3.500 ha, with potential for a gradual increase in the next years.

Rose production is based on experience and established traditions for many years. The regulation of flowering, respectively, yields of oil- bearing rose by pruning were studied by many authors (Kovacheva and Nedkov, 2009; Paskalev,1986; Paul et al., 1995; Porwal et al., 2002; Singh et al., 2002). Much of the research treatment methods and time of the applied pruning (Singh and Ram, 1987; Safari et al., 2004), annual pruning of the tops of the shoots (Astadzhov, 1980, 1988), pruning under the subtropical climate of India (Singh et al., 2002), pruning of ornamental roses with study the effect of application on the flower yield (Zarina et al., 2004) and essential oil (Hassanein, 2010).

Not enough information regarding a periodic basic (rejuvenating) pruning of oil – bearing rose, as applies in our country. After 8-10 years living , rose bushes lose its active growth and gradually reduce the flower yields (Topalov and Irinchev, 1967). To stop this aging, in rose-production practice has been doing periodically rejuvenate of the rose bushes. It is necessary when the surface part of bushes is damaged from frost, hail damage and other causes (Topalov and Irinchev, 1967). Studies on basic (rejuvenating) pruning of oil – bearing roses are associated with the study of

E-mail: n.kovatcheva@abv.bg

pruning depending on the degree of frost on the bushes (Tshachev and Paskalev, 1982), rejuvenating pruning under the mulch surface (Paskalev and Tshachev, 1982), rejuvenating pruning in connection with creation of a cutting apparatus (Todorov et al., 1989).

This study presents the effect on productivity in the first year after a basic pruning (rejuvenation) rose bushes and it is made and structural analysis of important parameters in species *Rosa damascena* Mill. *F. Trigintipetala* Dieck.

Materials and Methods

Experience is based in 2009 - 2011 of plants on eight old rose in the experimental field of Institute for roses, aromatic and medicinal plant (IREMK), Kazanlak, Bulgaria.. The shrubs are cut at the end of June 2010, immediately after flowering roses. Enclosed manual pruning of 5-10 cm from the base of the bush. By the end of vegetation, plantation be kept clean from weeds by two hand earthling in a row and three cultivation between row. The next year, care of the growing are under the adopted technology and include feeding 150 kg.ha^{-1} ammonium nitrate, earthling and cultivation between row.

We studied the four varieties of oil-bearing roses Eleina, Yanina, Svejen, Iskra, belonging to the genus *Rosa damascena* Mill. *f. trigintipetala* Dieck. The varieties were planted on the territory of IREMK, the block method, with 4 options (variety) in 3 repetitions, 16 m² in area harvested each. Biometric measurements were made during the flowering period on ten plant per variety and characteristics include: plant height (cm); plant diameter in row and between row (cm); number of basic twig per plant; number of flower twig per plant; number of vegetative twig per plant; number of flowers per one twig and number of flower per plant. The flowers are measured at full flowering stage, by ten flower of recurrence and include flower diameter (cm), flower weight (g), number of petal per flower. The flowers was picked daily, throughout the flowering, the total yield was recorded at the end of the rose picking.

The level of traits is determined by the average value and means of variation - by variation coefficient. The degree of correlation between the studied variables was analyzed in accordance with the coefficient of simple linear correlation of Pearson. Stepwise regression analysis was applied for assess the relationship between flower yield per plant as a dependent variable and other characteristics as independent variables. Information is generalize using factor analysis (PCA). The data were processed using statistical package SPSS.

Results and Discussion

The development of the rose bushes after basic (rejuvenating) pruning depends on the time of pruning, applied agricultural activities and weather conditions. Topalov and Irinchev (1967) recommended rejuvenating pruning be done on Autumn, because the cut parts can use for planting material or immediately after the rose-picking, to avoid zero harvest year. According to authors, summer rejuvenating pruning is risky when following period is drought, because the bush remain a weak growth.

In our study the results of measurement of the bushes are average genotype Table 1. The size of the bush and

Table 1
Average arithmetical (x), minimum and maximum values and variation coefficient of the morphological rose parameters

Characters	Units	x±sd	Min-Max	CV%
Plant height	cm	83.75±3.14	50÷120	23.71
Plant diameter in row	cm	94.30±4.93	40÷170	33.04
Plant diameter between row	cm	115.50±5.30	50÷200	29.03
Basik twig per plant	number	7.05±0.43	2÷16	38.44
Flower twig per plant	number	30.43±3.30	0÷72	68.49
Vegetative twig per plant	number	24.95±2.64	0÷69	66.97
Flowers per 1 twig	number	3.95±0.23	1÷10	37.47
Flower diameter	cm	6.74±0.06	5.8÷7.5	5.93
Petal per flower	number	40.80±0.66	34÷48	10.22
Weight 1 flower	g	2.71±0.05	1.9÷3.5	12.55
Flower per plant	number	78.58±4.94	46÷204	39.79
Flower yield per plant	g	210.25±20.87	101÷563	48.62

the number of basic twigs are indicators of the vitality of the rose plant.

Although minimum differences of bush's size between varieties (Figure 1), variety Eleina stands with known ability to form the smallest number of basic twig per plant (5.9) on which formed the largest number of flower twig per plant (42.9), the expense of the small number of vegetative twig per plant (9.3). (Figure 2). In combination with the number of flowers per twig (4.3), number of flower per plant (112) and flower weight (2.86 g) (Figure 3), the variety produced the highest yield from one plant (230 g), exceeding the remaining with 15% (Iskra), 23% (Yanina) and 48% (Svejen). Expressed by variation coefficient, the biggest variation is the number of flowering and vegetative twig per plant, 68.49% and 66.97%. The morphology of flower, as one of the enduring and significant signs of the species, has low coefficients of variation.

The correlation analysis shows that there are a strong positive correlation between flower yield per plant and weight 1 flower (0.519), which has had an impact on the flower diameter (0.418) and number of flower twigs per plant (0.450) (Table 2). By increasing the number of vegetative twigs per plant, reducing the number of flower twigs (-0.368), which explains the moderate inverse relationship to the flower yield per plant (-0.419). The width of the plant is determined by the formed basic twig (0.536). The increase in both characteristics have negatively affect by the total number of flower per plant (- 0.369, -0.380), respectively, on the flower yield per plant (-0.464, -0.305) in the first year after rejuvenating pruning, because the bush is in formation process .

In the correlation matrix not the coefficient greater than 0.7, therefore between factors there are not multicolinearity. In this case the classical multiple regression is not applicable and for predicting the flower yield in the first year after basic (rejuvenating) pruning is used stepwise regression analysis. Multiple correlation coefficient (Table 3) in the first step was significant (r = 0.519), and in the next two - strong (r = 0.704 and r = 0.827), so there are correlation between variables and yield per plant.

The first step coefficient of determination explains 27% of the variation in yield of all the factors together,

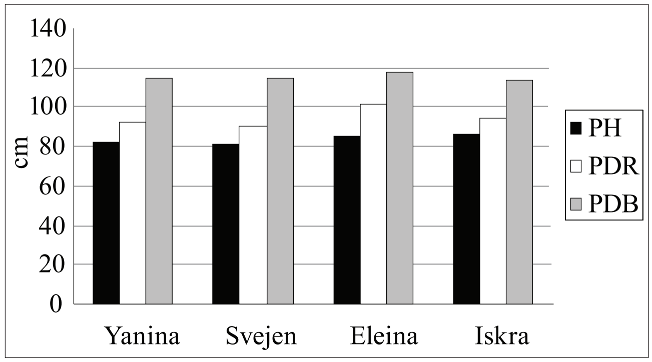

Fig. 1. Average values of the morphological parameters for different varieties oil-bearing roses: PH -Plant height; PDR - Plant diameter in row; PDB – Plant diameter between rows

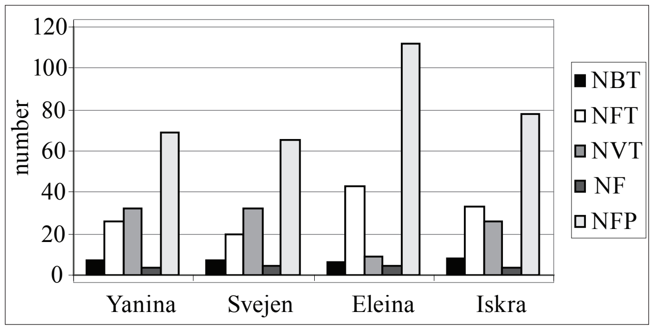

Fig. 2. Average values of the morphological parameters for different varieties oil-bearing roses: NBT - Number of basik twig per plant; NFT - Number of flower twig per plant; NVT- Number of vegetative twig per plant; NF - Number of flowers per 1 twig; NFP – number of flowers per one plant

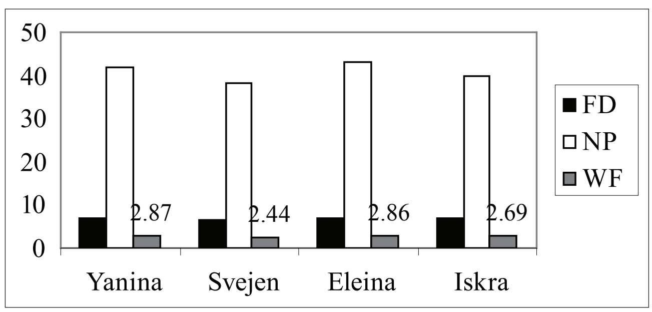

Fig. 3. Average values of the morphological parameters for different varieties oil-bearing roses: FD -Flower diameter (cm); NP -Number of petal per flower; WF - Weight one flower (g)

Table 2
Pearson's correlations between 11 characteristics and flower yield per plant

	PDR	PDB	NBT	NFT	NVT	NF	FD	NP	WF	NFP	FY
PH	0.268	0.102	0.311	0.216	-0.031	-0.054	-0.117	0.074	0.08	-0.194	0.003
PDR		0.389*	0.394*	0.429*	0.019	0.119	-0.057	-0.081	-0.064	-0.279	0.11
PDB			0.536**	0.387*	0.192	-0.020	0.142	0.023	0.005	-0.369*	-0.464*
NBT				0.376*	0.196	-0.070	-0.47	-0.276	-0.002	-0.380*	-0.305
NFT					-0.368*	0.031	0.197	0.133	0.450**	-0.054	0.089
NVT						-0.157	0.05	-0.056	-0.216	-0.257	-0.419*
NF							-0.075	-0.018	0.011	0.043	0.064
FD								0.302	0.418**	-0.171	0.176
NP									0.283	0.303	0.086
WF										0.03	0.519*
NFP											0.025

PH - Plant height (cm); PDR -Plant diameter in row (cm); PDB - Plant diameter between row (cm); NBT - Number of basik twig per plant; NFT - Number of flower twig per plant; NVT- Number of vegetative twig per plant; NF - Number of flowers per one twig; FD -Flower diameter (cm); NP -Number of petal per flower; WF - Weight one flower (g); NFP – number of flowers per one plant; FY - Flower yield per plant (g)
*, **, Significant correlation with P values <0.05, <0.01, respectively.

Table 3
Estimated equation for flower yield (dependent variable) based on stepwise regression

Step	Variable	R^2	St.err.	P<	Equation
1	WF	0.270	89.34	0.009	FY= -483.64+267.05 WF
2	WF, PDB	0.495	76.00	0.001	FY= -313.67+272.38 WF-1.62 PDB
3	WF, PDB, PDR	0.684	61.60	0.000	FY=--308.96+255.38 WF-2.69 PDB+1.58 PDR

R^2 – coefficient of determination, SE – Standart error, P – Degree of significant of equations (abbreviations as Table 2)

the second 49.5% and 68.4% the third. Analysis of significant coefficients of the models allows to draw equations describing productivity. The first step we obtain that the flower yield depends on the weight 1 flower. The second step determines the dependence of the flower yield per plant by weight 1 flower and plant diameter between row, and the third step includes plant diameter in row in order to determine flower yield per plant. In case there is incomplete correlation dependence, as in the regression model not participate all factors affecting by the yield, but only part of them.

Principal Component Analysisis revealed 3 factors explaining 72.48% of the total variation between the studied characteristics. Excluded the factor analysis variable plant height , flower per 1 twig, petal per flower, because no significant influence by correlation type on the dependent variable and on other variables. Selected as factors with eigenvalues> 1 (Principle of Kaiser). Factor analysis is adequate (KMO = 0.548> 0.5 and Bartlett's test of sphericity Sig = 0.000 <0.05, the determinant of the correlation matrix is 0.011> 0). The first factor explains 34.81% of the total variation and is associated with a variable plant diameter in row, plant diameter between row, number of basic twigs, number of flower twig per plant and number of flower per plant (Table 4), it consisted mainly bush size and flower per plant with negative sign.

PC2 is consists of number of basic twig per plant, weight 1 flower and flower yield per 1 plant and is responsible for 23.32% of the total variance. The flower diameter depends heavily on PC3, which explains 14.36% of the total variance. In agreement with the findings of Zeinali et al.(2009), a study of the relationships among traits could be beneficial to the breeders in their breeding programs, and the estimated PCs reveal how the characters affect each other.

Table 4
Principal component coefficient of 9 tested traits in *Rosa damascena* Mill.

Characters	PC 1	PC 2	PC 3
Plant diameter in row (cm)	0.818	0.122	0.006
Plant diameter between row (cm)	0.796	-0.393	0.165
Basik twig per plant (number)	0.741	-0.278	-0.007
Vegetative twig per plant (number)	0.115	-0.753	0.367
Flower twig per plant (number)	0.855	0.356	-0.07
Flower diameter (cm)	-0.031	0.097	0.904
Weight one flower (g)	0.194	0.652	0.473
Flower per plant (number)	-0.574	0.163	-0.434
Flower yield per plant (g)	-0.126	0.837	0.213
Percent Variation	34.81%	23.32%	14.36%
Cumulative percent of total variance	34.81%	58.13%	72.48%

Conclusion

Main effect of pruning (rejuvenation) in individual varieties of oil-bearing roses is different. With the best productive capacity is differs variety Eleina. Of the studied signs of greatest variation are number of flower twig and vegetative twig per plant, 68.49% and 66.97%, while at least - the dimensions of flower. There was a strong positive correlation between flower yield per plant and weight 1 flower (0.519). The developed regression models largely can to predict yields. PC analysis reduces the original characteristics in the experiment of 3 main components, explaining 72.48% of the total variation.

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Received December, 1, 2011; accepted for printing May, 12, 2012.