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FORMATION DYNAMICS OF THE REPRODUCTIVE PARTS OF THE PEA CULTIVARS WITH VARIOUS TYPES OF BEAN

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ABSTRACT

Weather conditions influence on the formation dynamics of the reproductive organs of pea cultivars with various type of bean has been studied. The genotypic features of flowering, fruit and seed formation productivity have been revealed. A high productivity of the seed formation of cultivar «Kaban» with undisclosed beans and equable load distribution of seed weight on productive nodes has been detected. In adverse conditions at «Tan» and «Venets» cultivars the seed weight was formed on two productive nodes. The load of the lower node increased, which share reached 70.8 and 73.8%. «Kaban» cultivar characterized by more synchronous development of productivity on a plant. Almost a half of the seeds weight fell on lower productive node regardless of the year conditions.

KEY WORDS

Peas; Cultivar; Yield; Flowering; Formation; Beans; Seeds; Productive node.

In production conditions, cultivar competitiveness evaluated by its ability to implement maximum productivity potential under influence of external environmental factors [4]. Formation of pea productivity elements is defined by the conditions presented at all stages of plant ontogenesis. Pea plants are able to generate a large number of buds, flowers and beans. But the level of the implementation of genotypes seed productivity is highly dependent on weather conditions. At the different stages of plant development there is a significant loss of mortgaged potential under the influence of weather factors. In the conditions of Tatarstan, flowering productivity of plants varies between 85 – 95 % under field conditions, and the productivity of beans formation may fall to 53 % [7, 9]. Depending on the cultivar and growing conditions, part of the pea ovules remains sterile or gives defective seeds. Plants bear a significant amount of the unproductive expenses of mass and energy by abscission of flowers. The productivity of seeds formation from ovules often does not even reach 50% [2]. The results of physiological studies confirm that the uneven flow of assimilation products and the formation of productivity elements caused by the alternate location of productive nodes on pea plants. At the same time lower nodes are in a better position [3]. According to available data, fluctuation of the share of undeveloped ovules in a bean up to 30 % may be related to ecological factors, about 3 % of differences fall to the share of an intervarietal component [6].

Many selectionists linked the increase of pea productivity with increasing the values of the individual elements of efficiency. By directing the selection process to the uniform distribution of productivity elements on fertile nodes by reducing the share of the lower, you can achieve high uniformity of seeds per plant and more fully realize the potential [1, 5, 8].

Presence in the global gene pool of genotypes with high expression of traits regulating realizing potential gives the opportunity to improve the adaptive properties of cultivars in the selection process. The importance of researches on expansion the diversity of the gene pool of culture, with the advent of various morphological mutants and their features in relation to abiotic factors, increases. The task of comparative study of the formation features of the reproductive organs on the fertile nodes of pea cultivars with shelling and seamless beans is

of interest for practical selection in order to find and intrude sources with high seed productivity, low reaction to the influence of abiotic factors into genotypes. Clarification of the contribution values of genetic and environmental components in the development of this trait seems highly relevant.

MATERIALS AND METHODS

In 2012-2013 in a field experiment leafy cultivars of peas from State Scientific Institution Tatar Scientific Research Institute of Agriculture, which differ by the type of bean, were studied. Shelling cultivars «Tan» and «Venets» and a new cultivar «Kaban» were compared to «seamless» beans. On the plots of studied cultivars, stationary sites were laid with labeled and tied up plants, on which, starting from the phase of buds formation, daily counts of formation and loss of buds, flowers and beans on each fertile node were conducted. Formation productivity of flowers, beans and seeds on productive nodes and on the plant as a whole was calculated in percentages.

Registered plants were cleaned into sheaves when ripe. The plants were analyzed for the following parameters under laboratory conditions: the number of full beans on each fertile node, number of seeds per fertile node, seed weight on fertile node.

RESULTS OF RESEARCH

In the years of carrying out researches during vegetation of peas there were contrast weather conditions. Analysis of weather data showed that average daily air temperature during the studies in all phases of plant growth exceeded the average annual values. In the phase of reproductive parts formation maximum deviations from the norm were marked. In 2012 it reached 3.2 °C in the budding phase (2nd decade of June), in 2013 – 5.2 °C at the end of flowering and bean formation (third decade of June).

The extremely nonuniform distribution of a rainfall on phases of plants vegetation and by years was observed. During the periods of the maximal water consumption by peas (a phase of the linear growth of plants, blossoming, formation of beans and seeds) the rainfall in 2012 every ten days made 8.3 – 123.0 %, in 2013 – 7.8 – 68 % of norm.

During the vegetation period of peas in the years of researches hydrothermal coefficient was 0.72 and 0.60 respectively. In the phase from emergence to full flowering and during the flowering period the values of hydrothermal coefficient in 2012 reached 1.10 and 1.27, which points to more favorable conditions for the linear growth and formation of plants productivity. Low values of the hydrothermal coefficient during these periods in 2013 (0.22 and 0.81) testify to the prevailing stressful conditions for peas plants. This year the vegetative period of pea cultivars was reduced by 8 days in comparison with the previous. The number of productive nodes, number of flowers and beans on plants was reduced, the quantity of undeveloped ovules increased.

On the contrary, the share of flowers and beans formation at genotypes in harsh conditions increased. The analysis of flowering productivity as a percentage showed that cultivars with well developed parchment layer of beans flaps had advantage. Their values by years varied within the range 86.5 – 100 % (Table 1). The maximal value of a trait is noted at «Tan» cultivar, which has all buds blossomed in stressful conditions of 2013. The new grade «Kaban» was characterized by the low level of realization of flowering efficiency. The index of trait within two years amounted on average 80.3 %, by years it ranged within 78.2 - 82.5 %. But by the share of fruit and seeds formation this cultivar showed a significant advantage compared to shelling cultivars. Under the conditions of 2012, 67.2 % of its flowers formed full-fledged beans. In shelling cultivars «Tan» and «Venets» the value of fruit formation productivity was 56.4 % and 51.9 %, respectively.

In dry conditions of 2013 there was an increase of trait indices of presented cultivars which were 76.9%, 60.5 % and 58.0 %, respectively.

The distinction of cultivars by seed productivity remained. This distinction increased under stressful conditions of 2013. Productivity of the seed formation of «Kaban» cultivar

increased from 61.2 % in 2012 to 77.8 %. In droughty conditions, indexes of this trait of «Tan» and «Venets» cultivars are significantly lower – 58.7 % and 55.1 %.

Seed weight per plant decreased by 33.8 % at «Tan» cultivar, «Venets» - by 61.9 % and «Kaban» - by 39.5 %. «Venets» cultivar characterized by greatest reaction to changes of environmental conditions, the seed weight of this cultivar decreased from 4.30 to 1.64 grams per plant. Cultivar «Kaban» showed stability for a given trait. Its value by years was 3.72 and 2.25 g/plant.

Table 1 – Efficiency of flowering and formation of beans and seeds of pea cultivars with different types of bean by years, %

Cultivars	Years	Flowering	Beans formation	Seeds formation
Tan	2012	95,4	56,4	61,3
	2013	100,0	60,5	58,7
	average	97,7	58,4	60,0
Venets	2012	86,5	51,9	59,6
	2013	94,3	58,0	55,1
	average	90,4	54,9	57,3
Kaban	2012	78,2	67,2	61,2
	2013	82,5	76,9	77,8
	average	80,3	72,0	69,5

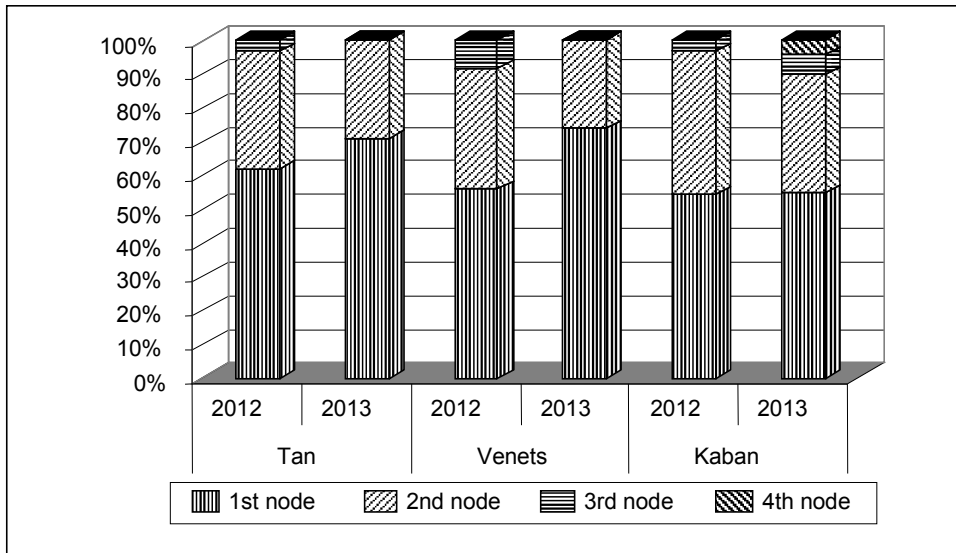


Figure 1 – Distribution of seed weight on productive nodes, %

Under changing weather conditions, the distribution of genotypes productivity varied on fertile nodes. In adverse conditions at «Tan» and «Venets» cultivars the seed weight was formed on two productive nodes. The load of the lower node increased, which share reached 70.8 and 73.8% (fig. 1). «Kaban» cultivar characterized by more synchronous development of productivity on a plant. Almost a half of the seeds weight fell on lower productive node regardless of the year conditions.

In stressful conditions four productive nodes formed on the plant with the gradual reduction of load from the lower to the upper with a ratio of 54.7, 35.1, 5.8 and 4.4%.

CONCLUSIONS

In the cultivar «Kaban» the redistribution of assimilation products aims to strengthening the processes of the formation of beans and seeds. Higher resistance to the stressful environmental conditions of a new cultivar is caused by an increase in the number of productive nodes and synchronous load distribution of seed weight on them.

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