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PRELIMINARY STUDY OF BEAN PHENOLOGYCAL AND PHISIOLOGYCAL PARAMETERS TO DETECT VALUABLE TRAITS FOR BREEDING

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Key words: *germination, flowering, pod development, soluble solids, pathogen attack*

INTRODUCTION

According to published studies and (inter)national reports the common bean represents one of the most intense cultivated *Phaseolus* species after soybean and peanut. Related direct human consumption, common bean own first place in consumers preference, being a valuable source of protein, minerals and vitamins (Broughton et al., 2003). There are a plenty of different consumption ways, fresh seeds and pods, dry seeds, preserved as dehydrated fresh pods. The rest of the plants can be totally used in different organic fertilization combinations, as animal fodder and the dry pods as remedial. Tremendous progress has been reported related bean ability to adapt to environmental changes, especially to the most restrictive stressors heat and acidic soil conditions.

The capacity to understand the response mechanisms of species allowed significant contributions to the development of new bean adapted genotypes. Studies of (Salazar, 2018) concluded that the knowledge related to morphological, physiological, agronomical and genetic are needed for successful breeding programs aimed to develop new resilient resources able to increase food security and ensure proper nutrition in the current context of climate change, also in agreement to (Beebe et al. 2011; Rao 2014). The role, the impact and the multiple benefits of legumes motivated an ambitious plan at EU level aimed to create and implement strategies to increase the cultivated surfaces with the final purpose of positive impact in human and environment health. A plenty of various molecular techniques, genome-wide association studies (GWAS), PCR and many other were developed lately to investigate genetic diversity.

The availability of novel varieties will facilitate the adoption of food legumes in the agroecosystem improving the agrobiodiversity with all its related positive consequences associated to the inclusion of legumes in the cropping systems (e.g. sustainability, food security, economic returns, stable farming systems, increase of soil fertility, diversify products, improve human nutrition, etc.).

MATERIAL AND METHODS

The biological material was represented by 30 genetic resources: varieties currently used in production; varieties withdrawn from production, due to the introduction of other new superior varieties; local populations; lines.

The experimental device was displayed in open field in conventional system, in four replicates.

The working methodology for pre-breeding included phenotypic characterization focused on characteristics related to productivity, early maturity, resistance, tolerance to pathogen attack.

(i) productivity (% germination, number of viable plants, number of pods per plant, length, width, shape of pods, presence of threads, average number of seeds in the pod, MMB).

(ii) earliness (number of days for germination 50% of the sample, interval ensuring complete germination, interval until flowering, flowering 50%, total flowering, tying of pods, time of harvesting pods at consumption maturity, physiological maturity)

(iii) resistance, tolerance to pathogenic attack

- screening for: *Xanthomonas campestris* pv. *phaseoli*, *Alternaria alternata*.
- pests specific to the bean crop, in the experimental fields there was an attack of Bean weevil - *Acanthoscelides obtectus*, Corn earworm *Helicoverpa armigera*.

The determination of total dry matter substance was carried out by weighing the fresh vegetal material, drying it for 24 hours at 105°C, cooling it outside and then weighing again the dry vegetal material. The obtained results were expressed in percentage. The difference till 100% represents the water content.

The content of mineral substances in the pods tissues was determined gravimetrically. The plant material was weighed, then calcined at a temperature of 1000 °C. After cooling in a desiccator, re-weighed and the results were expressed as a percentage (g 100 g^{-1} of fresh material).

The soluble dry matter content was determined using refractometer method and then expressed in percentage.

Special works related to biological purifications as well as the selection and marking of elites were implemented according to (Mureşan, 1972).

RESULTS AND DISCUSSIONS

Seed germination performance has a huge impact on crop yield, being in the same time a precondition for conservation of plant genetic resources to ensure sustainable uses. The germination percentage varied between 80% and 100%, with an average of 93.63%. Four genotypes: Ph.na V15, Ph.na V17, Ph.na V22, Ph.na V23 recorded maximum values of germination, and another 16 genotypes recorded a higher percentage than the average of the working collection (figure 1).

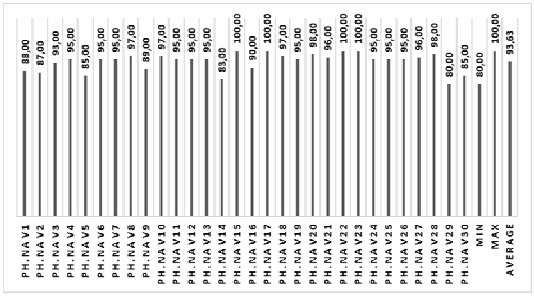

Fig. 1. Germination percentage of investigated material

Among the phenological observations made we mention: date sown, number of days required for emergence, number of days until beginning of flowering, number of days needed for 50% flowering, number of days for 100% flowering, number of days until the end of flowering, number of days required until starting moment of harvest, number of days until pods physiological maturity.

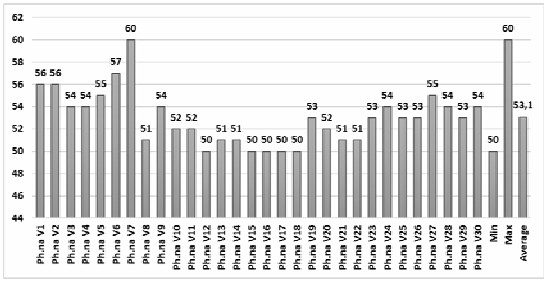

Fig. 2. Interval from sowing to first harvest of immature pods (consumption maturity)

The main objective was to identify the genetic resources characterized by earliness, (in the context of specific conditions of the experimental climate, marked by early frosts) - reducing the length of growing season is one important objective of breeding program of species *Phaseolus vulgaris*, in cold areas.

The sowing was done on May 10, the emergence occurred in an interval of 4-6 days, with an average value of 4.8 days. The beginning of flowering occurred in 38-46 days after sowing.

The pods for fresh consumption are usually harvested in stages, the beginning of the harvest being between 50 and 60 days after sowing. The immature pods were harvested for investigations when they have reached the specific dimensions of the cultivar/ variety, the specific color, no grains have been formed (seeds) and the texture is tender and juicy.

Five genotypes (Ph.na V12, Ph.na V15, Ph.na V16, Ph.na V17, Ph.na V18) had a rapid rate of pod formation requiring a period of 50 days from sowing to harvest at consumption maturity.

13 genotypes were placed between the minimum value (50) and the average around the average value (53.1) for obtaining the pods. The latest genotype required a number of 60 days for the formation and growth of pods, and the remaining 11 genotypes formed the pod harvest in above average range value. (figure 2).

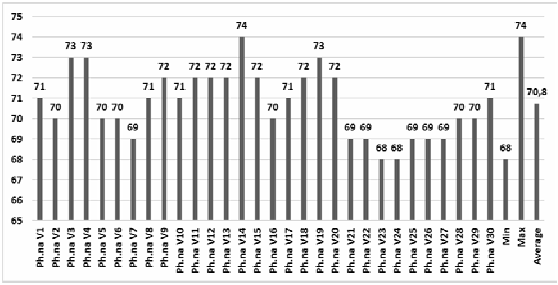

Fig. 3. Classification of genotypes according to the number of days required till physiological maturation of the pods

In breeding and seed production, an important indicator is the physiological maturation of pods / seeds to establish the length of vegetation period. As a benchmark was used the moment when the pods begin to change color - considered the beginning of physiological maturation and values were recorded between 68 and 74 days (figure 3).

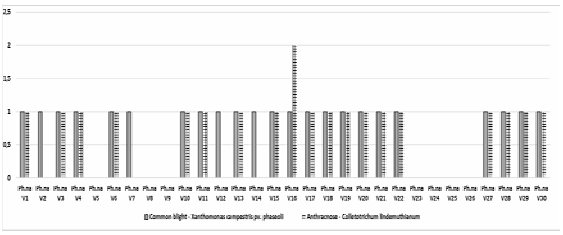

Fig. 4. Diseases identified on pods and seeds from experimental variants

Related pathogen attack, on the pods and seeds in the experimental variants have been identified symptoms of common blight - *Xanthomonas campestris* pv. phaseoli and anthracnose *Colletotrichum lindemuthianum phaseoli*.

As pests were identified *Acanthoscelides obtectus* and *Helicoverpa armigera*.

Among the genotypes analyzed in seven from the total, no symptoms of common blight/ or anthracnose were identified. Two genotypes showed common blight symptoms, and the rest showed symptoms of both diseases (low attack), with the mention that in the case of Ph.na V16 anthracnose was intense (Figure 4).

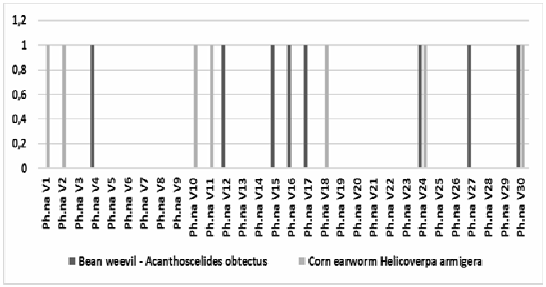

Fig. 5. Pests from experimental variants

The main pests identified were *Acanthoscelides obtectus* (6 attacked genotypes) and *Helicoverpa armigera* (5 attacked genotypes).
Two genotypes were attacked by both pests. The degree of attack was manifested in low limits in all experimental variants (figure 5).

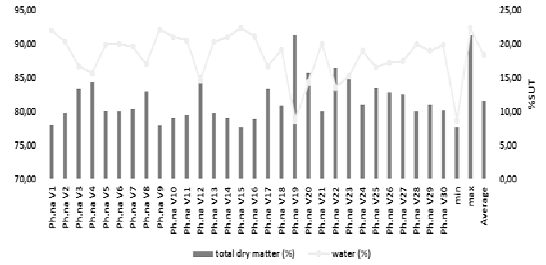

Fig. 6. Variation of total dry matter and water content in the investigated genotypes

The total dry matter is composed of both organic and inorganic compounds, soluble or insoluble and is a quality indicator for pods.

The analysis of the pods from the experimental variants were performed during the period of consumption maturity, and they highlighted a variation of total dry matter in wide limits, from a minimum of 7.68% to a maximum of 21.36%. The average value of this indicator was 11.65%.

The mineral content was detected flowing the investigation of total dry matter and water content. The group of 30 resources can be divided according the mineral content in four groups (figure 7).

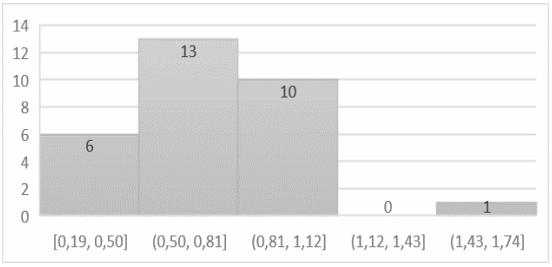

Fig. 7. Synthesis of results related mineral content

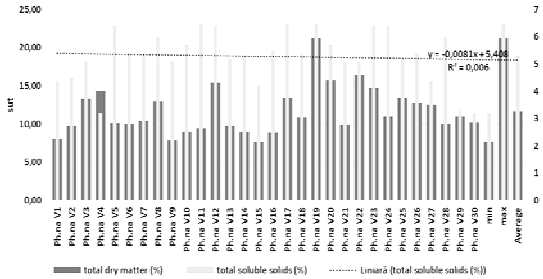

Fig. 6. Variation of total dry matter and total soluble in the investigated genotypes

The soluble dry matter is the most accessible quality indicator, the determination being achieved quickly, with the help of a refractometer. It is also an important quality indicator, being composed mainly of soluble carbohydrates (glucose, fructose and sucrose), along with organic acids, amino acids and minerals. The variation of soluble dry matter was from 3,20% to 6,50%, and the average value was 5,30%.

Purification was performed 3 times for a dual purpose. The first purification that was done in the cotyledon phase of the sprouted plants, aimed to eliminate the bacteriosis.

The other two purifications are made to ensure the authenticity material. The second purification is done during flowering, taking into account the shape and volubility of the bushes, the moment of appearance, the color and the way of inserting the flowers; the third purification was done at the moment of physiological maturity of the pods taking into account their properties regarding the shape, size, color, external appearance of the pods, number of grains in the pod, their shape and color.

The elite plants are the ones that represent in the highest degree the typicality of the variety and are distinguished by high productivity, good phytosanitary status. The seed of each elite were extracted and kept separately. The number of elites drawn was 300 due to the high percentage of allogamy (up to 50%).

CONCLUSIONS

It is extremely important that genetic resources to be protected through the implementation of programs for feasible conservation. In addition, it is essential for resources to have real chances of survival through the implementation of national programs. for conservation.

Ph.na V12, Ph.na V15, Ph.na V16, Ph.na V17, Ph.na V18 had a fast rhythm of pod formation, requiring an interval of 50 days from sowing to the beginning of harvest - consumption. Ph.na V7 required a number of 60 days for the formation and growth of pods.

Ph.na V23 and Ph.na V24 needed 68 days to reach consumption maturation.

The variation of soluble dry matter was from 3,20% to 6,50%, and the average value was 5,30%. Total dry matter content varied in wide limits, from a minimum of 7.68% to a maximum of 21.36%. The average value of this indicator was 11.65%. The degree of pest attack was manifested in low limits in all experimental variants.

Two genotypes were attacked by the common blight, and the rest showed symptoms of both diseases (low attack), with the mention that in the case of Ph.na V16 anthracnose was intense.

The results are preliminary more data are needed to fulfill the objective of the study – detection of traits and resources valuable for breeding.

ABSTRACT

The paper presents the results of a study of a collection of 30 bean resources grown in open field conditions. The bean resources were characterized in terms of germination rate, flowering, pod development, pathogen resistance, yield components, soluble solids, dry matter, mineral and water content. The first step of investigation allows us to select the valuable genetic material in terms of earliness, productivity, quality, tolerance/ resistance to pest and pathogens.

ACKNOWLEDGEMENTS

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