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NEW RESULTS OF THE WINTER PEAS BREEDING PROGRAM AT NARDI FUNDULEA

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Abstract

Breeding winter cultivars requires the combination of freezing tolerance as well as high seed productivity and quality.Winter peas have some advantages over spring peas like: better establishment and more efficient use of humidity during the winter season, which makes it less vulnerable to drought over the spring, frequently in Romania in the last years; earlier harvest; has a longer vegetation period and get higher productivity and more stable yield than spring peas type. In this paper we present data obtained from the first F4 and F5 lines of winter peas obtained in the NARDI-Fundulea program with the germplasm of winter peas from USA, France and Austria. A number of 170 lines, selected from winter/winter and winter/spring crosses pea genotypes, have been tested in 2019 in the field of NARDI Fundulea.The conclusion of this preliminary study is that will be possible to realize the genetic progress in breeding in winter peas, to select the new varieties with good enough winter hardiness and being with high yield, different earliness or plant height.

Key words: *winter peas, winter hardiness, earliness, yield.*

INTRODUCTION

Field pea *(Pisum sativum* L.) is an important annual legume grown and consumed extensively both human and animal feed (Mustafa Tan et al., 2012). The use of plant proteins as functional ingredients in the food and feed industry is increasing and special attention has been paid to the use of peas because they are already accepted as a part of the human and animal diet throughout the world (Rodino et al., 2009). It is economically very important for many agricultural systems, but the relative importance of abiotic stresses affecting its production is poorly understood. Field pea has inadequate tolerance at the reproductive stage to winter stresses, particularly frost. (Shaista Shafiq, 2012).

Winter peas (*Pisum sativum*) is a cool-season annual legume that has long been considered a high-preference forage for whitetails. Due to its nitrogen-fixing ability, winter pea has numerous agricultural uses, and it is very easy to establish in fall food plots.

Winter peas are broadly adapted to dryland production in all regions where winter wheat is grown, and the improved cold hardiness of winter peas rivals that of winter wheat.

Winter hardiness in peas is a complex combination of phenotypes that the plants express in response to environmental cues.

Winter hardiness in peas is a combination of acclimation, tolerance, and avoidance. As the autumn temperatures fall, days shorten, and spectral quality of light changes, the plants become acclimated to cold temperatures. Some of the physiological characteristics that have been associated with the process of cold acclimation in peas are the accumulation of sugars in leaves, stems, and roots (Bourion et al., 2003) and an increase of the RuBisCO activity (Dumont et al., 2009). When peas that are cold acclimated do experience freezing temperatures, there is less electrolyte leakage than in non-acclimated peas, and associated QTL have been identified (Dumont et al., 2009).

Winter peas (*Pisum sativum* L.) are an alternative. Planted in late summer to early autumn, winter peas confer all of the advantages of spring-planted peas. With symbiotic Rhizobia bacteria, they fix atmospheric N, making them a low-energy and low-greenhouse-gas-emissions crop; they interrupt weed, disease, and insect cycles; have a relative low water use; and can flourish under

current crop management practices with existing farm equipment. In addition, their greater yields compared with spring peas make them economically viable, and late-summer planting shifts fieldwork to avoid the vagaries, narrow planting window, and variable conditions that constrain spring-planted peas.(Rebecca McGee, 2017)

MATERIALS AND METHODS

In 2019, the first 94 F4 peas lines were tested in preliminary comparative cultures (46 F4 lines) and comparative cultures (48 F4 lines) with 25 variants in three replications, on a plot of four m^2 harvested area.
The 76 F5 peas lines were tested in preliminary micro-cultures, each of them with 25 variants, one replication, on a plot of four m^2 harvested area.
The 2019 winter was slight enough, with a short period with negative temperatures of -16°C (the begining of January), with a snow layer, which has protected the crop. There are no damages registered due to frost. The early spring was normal, fact that led to restart the vegetation under optimum conditions.
The level of resistance to winter hardiness was estimated in the field, early in the spring, in a scale 1 to 9, where score 1 is very resistance and 9 very susceptible. Plant height was measure in cm, total length of plant from the ground till the top to the end of flowering time. The earliness was appreciated like number of days from 1st January till the end of flowering time and yield as kg/ha.
The statistic analyses of data have been evaluated by correlations and linear regressions between study traits.

RESULTS AND DISCUSSIONS

Yield performances lines of F4 and F5 generation, tested in advance trials and respectively in preliminary trials in 2019, (Figure 1) shows that the coefficients of correlation are significant high (r = 0.26***) so the coefficient of heredity is in sense large and shows the genetic transfer between generations.

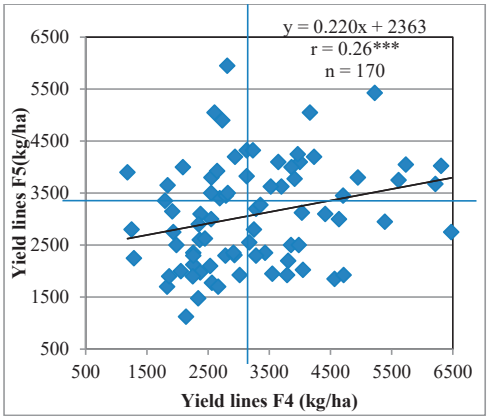

Figure 1. Correlation between yield F4 and of F5 data of 170 lines of the winter peas

Having in view that winter hardiness in winter peas is a very important trait, there was necessary to highlight in what way this trait could be recombined with other important agronomical characteristics, like earliness to flowering, plant height, grain yield as well as the relationship among other traits as plant height/earliness or yield/earliness.
In the Table 1 are presented such correlations using the data collected from 48 F4 lines and 46 F4 lines tested in comparative cultures and respectively in preliminary cultures in 2019.

Table 1. Correlation coefficients among different traits in F4 winter pea lines

The generation these genotypes	Correlation between different characters	The correlation coefficient
48 F4 lines tested in comparative cultures in 2019	Winter hardiness/yield	0.18ns
	Winter hardiness/earliness	0.06ns
	Winter hardiness/plant height	-0.14ns
	Plant height/earliness	0.38***
	Yield/earliness	-0.38***
46 F4 lines tested in preliminary comparative cultures in 2019	Winter hardiness/yield	**-0.28***
	Winter hardiness/earliness	-0.08ns
	Winter hardiness/plant height	-0.24ns
	Plant height/earliness	**0.57*****
	Yield/earliness	-0.57***

The correlation between winter hardiness and yield in F4 lines (Table1) was significantly negative (r = 0.18 and r = -0.28*), what means that in winter peas is absolutely necessary to

cultivate genotypes with good level of winter hardiness, to realize high and stable yields.
Also relationship between plant height and earliness was very distinct significantly (r = 0.38*** and r = 0.57***), strong enough in some case, what mains that it quite easily to be recombine such characteristics.
The correlation, between plant height and winter hardiness, was negative significantly (r = -0.14 and r = -0.24), but so that suggests possibility to select the genotypes which recombine both traits.
The relationship between yield and earliness, in F4 winter pea lines was very distinct signify-cantly negative, (-0.38*** and -0.57***), however demonstrate the existence of lines with high yield and with earliness. The correlation between yield and winter hardiness of F5 lines had (Figure 2) was very distinct significantly among those traits (r = 0.25***). So that, the distribution of the lines demonstrated existence the lines with the same level of winter hardiness and with high level of yield.

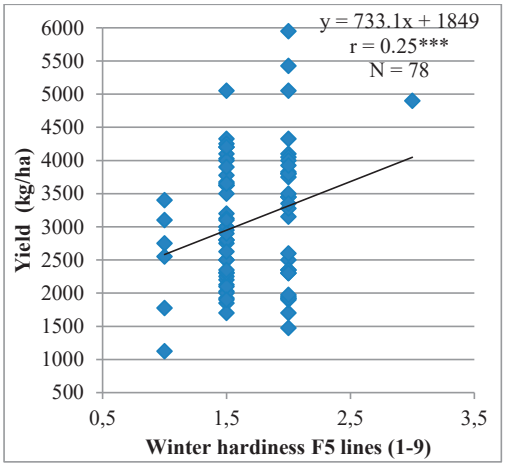

Figure 2. Correlation between winter hardiness and yield of F5 lines winter peas

Also it is very important to select the perspective lines with good yield potential but in the same time to recombine an acceptable earliness for Romanian climate conditions.
The distribution of the 76 of F5 lines for precocity (Figure 3), divides the breeding material in two groups of maturity: late forms and early forms.

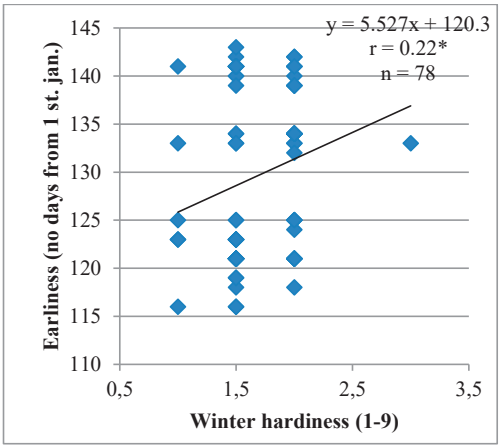

Figure 3. Correlation between winter hardiness and earliness of F5 lines winter peas

The data obtained till now form the study of relationship between winter hardiness and plant height indicated the possibility of recombination of both traits of interest (plant height and winter hardiness) (Figure 4) suggesting that, in functions of the end use the production, for forage need to be a tall variety, for high biomass production or mid tall variety for grain type.

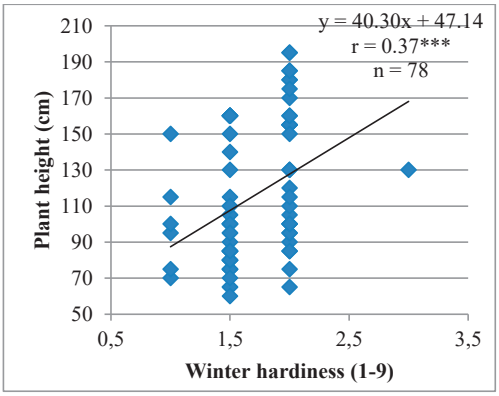

Figure 4. Correlation between winter hardiness and plant height of F5 lines winter peas

The date obtained between correlation plant height and earliness shows separation of the material în two category, with plant height 50-

110 cm and with earliness and with plant height 150-200 cm and tardive (Figure 5).

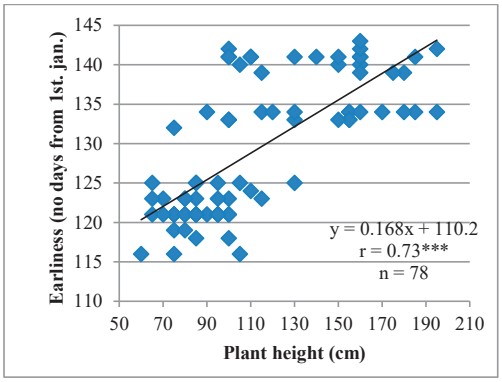

Figure 5. Correlation between plant height and earliness of F5 lines winter peas

The relationship between yield and earliness is insignificant negative (r = -0.15), however demonstrat the existance of lines with high yield and with earliness, those are the most important traits which must present a new varieties winter peas (Figure 6).

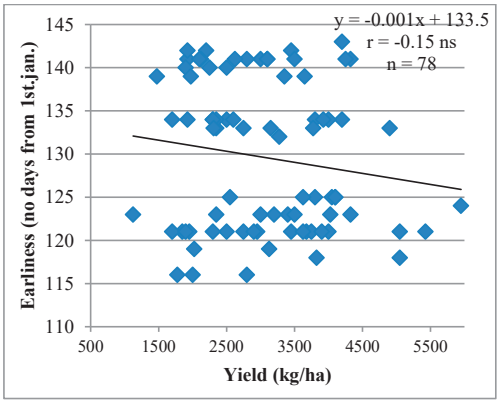

Figure 6. Correlation between yield and earliness of F5 lines winter peas

CONCLUSIONS

The data obtained in these studies, on the advanced lines shown existance the important lines of winter peas which posed high yield, good level of winter hardiness, plant height and earliness.

In this study were remarked winter peas lines F5 with good level of winter hardiness, with high yield (5000-6000 kg/ha), earliness and with the plant height between 130-145 cm, this trait is very important for varieties of winter peas because can utilized both as pure crops and for cereal grain mixtures (high biomass).

In the near future, some of these winter peas lines will be tested for registration of winter peas cultivars, adaptated of the climatic conditions of Romania.

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