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BREEDING ORIENTATIONS FOR DRY PHASEOLUS VULGARIS BEANS IN HAITI

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INTRODUCTION

Among food crops harvested by Haitian farmers, dry Phaseolus vulgaris beans are especially important, both quantitatively and qualitatively, for their economical and nutritional value.

Other pulses, like Cajanus cajan, Vigna unguiculata, Phaseolus lunatus, Lablab niger, Vigna umbellata, Vigna radiata, Phaseolus dervinianus are not grown in such a large amount, and in less diversified environments.

GROWING CONDITIONS, LIMITING FACTORS FOR YIELD

The Madian-Salagnac team used a transcet through the South Peninsula of Haiti and identified elevations from sea level to 950 m (3,000 ft.).

Phaseolus vulgaris beans are supposed to have a thermal range between 15°and 33°C, an optimum temperature near 24°. They need more or less than 3.00 mm of rain: these climatic requirements, combined with diseases and pests occurrence, explain the variations observed for sowing periods, and for the number of successive crops during the year at various elevations.

Farmers can hope some rains between March and December. Maximum temperatures are always superior to 30°C at sea level, they can reach 35-36 in July-August. At 900 m elevation, they are never superior to 30°.

At sea level, farmers who have some irrigation water sow their Phaseolus vulgaris beans in December. At 500 m elevation sowing is done in March and September, at 900 m in March, July and October.

Haitian farmers sow their beans either in pure stand, or associated with other crops.

At Salagnac (900 m) pure stands are sown in October, with populations of approximately 600,000 plants/ha. In March and July, beans are more often sown on mounds in association with sweet potatoes and maize.

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Yields obtained by the haitian farmers are relatively low, around 0.5 t/ha in pure stand, however not inferior to latino-american average.

Low soil fertility and diseases are the principal causes of these low yields. We have observed on bean leaves and pods:

fungi:	Anthracnose	(Colletotrichum lindemithianum)
	Powdery mildew	(Etysiphe polygoni)
	Angular leafspot	(Isariopsis griseola)
	Rust	(Uromyces phaseoli)
	Target spot	(Chatoseptoria wellmanii)
	Cercosporiosis	(Cercospora castellani)
	Leaf smut	(Entyloma sp.)
	Web blight	(Rhizoctonia microsclerotia)

bacteria: Common blight (Xanthomonas phaseoli)
(only once, and in special conditions)

viruses: Common bean mosaic virus (BCMV)
Golden bean mosaic virus (BGMV)

pests: the most important is probably Empoasca sp.

Some of these diseases prohibit Phaseolus vulgaris growing in some places and seasons: for example, golden mosaic and Empoasca at sea level for sowing in any month except December.

Other ones are the causes of 30% to 50% losses, for example powdery mildew for crops sown in October at 500-900 m elevation.

A modest fertilization (0-40-50) combined with two fungicide applications can experimentally improve the yields from 0.5 to 1.5 t/ha with local varieties. Fertilization alone aggravates the severity of leaf diseases (rust, powdery mildew). Nitrogen allows development of bacterial common blight. Fungicide alone makes the leaves healthier, but does not improve yields.

This modest fertilization may be realized by farmers themselves (500 kg wood ashes + 30 P_2O_5 units/ha). But they have not the possibility to realize fungicide application.

A french bean breeder, H. Bannerot, who visited the Madian-Salagnac area in 1976 had observed that a minority of plants were less attacked by powdery mildew and rust in October sown fields. This observation led to the following idea: "from the very diversified bean germplasm grown by haitian farmers, isolate or breed pure lines able to yield 1,5 t/ha with phosphopotassic fertilization but without fungicides."

THE HAITIAN BEAN GERMPLASM

A simple glance on the beans sold on the haitian markets gives a first idea of the extreme diversity of this germplasm: one can find black,

red, purple, pink, yellow or white beans, of several shapes and sizes, with at the least three types of variegations. This heterogeneity of the seed morphology does not account for other heterogeneities, for plant morphology (determinated versus indeterminated growth), yield potential, and disease resistance. Even reassorted for color, shape and variegation, a lot of haitian beans homogeneous for the eye will give a number of pure lines different for plant morphology, yield potential and disease resistance.

In the Madian-Salagnac area: people grow mixtures of approximately:

30% large variegated red beans
30% medium-sized black beans
30% small pink beans, which are not sold on the markets
10% beans of various colors, shapes, and variegations, not belonging to the categories above.

Growing such mixtures is not a consequence of inadvertance or under development:

Large variegated red beans, which are sold at the highest price on the markets are produced by dwarf plants. Their multiplication rate is the lowest, they must be sown at high population rates (600,000/ha - 180 kgs) to obtain no more than 0.5 t/ha. Black beans and small pink beans are produced by intermediate plants, their multiplication rate is higher, especially for the small pink ones which, however, are not commercial.

On the other hand, the blooming period of dwarf plants is short, and more susceptible to climatic accidents, especially drought, than the longer anthesis period of indeterminate plants.

Therefore, the mixture allows both reduction of harvest uncertainly, and economy of the amount of seeds to be sown.

SAMPLING PURE LINES AND BREEDING NEW LINES FROM HAITIAN GERMPLASM

Pure lines were extracted, either from beans bought in the markets, either from plants observed as better than their neighbours in the farmer's field, the second method being, of course, better than the first.

We have so obtained 48 pure lines, very different from each other, a collection which may give an idea of the diversity of the haitian bean germplasm, but which is obviously only a small part of the whole.

17 of them seem to be very interesting either for yield potential, or for other characteristics: powdery mildew or rust resistance, tolerance to soil acidity complex, for example. However, only one of these pure lines combines enough qualities to be distributed to farmers: "Salagnac 86", a large variegated red bean, produced by dwarf plants resistant to powdery mildew, tolerant to rust and other leaf diseases, moderately tolerant to soil acidity complex.

Its coloration, however, is perhaps slightly too pale to be sold at the highest price.

We have not found pure lines of medium sized black beans or small pink beans combining such a number of qualities.

We have therefore made hybridizations between the best haitian pure lines, in order to obtain:

1. with a backcross program, a better colored "Salagnac 86" (the same operation is ended with a very early powdery mildew resistant line, "Kenscoff I".

2. from a cross between "Salagnac 131" (highest level of powdery mildew resistance) and "B 789" (a good yielder black bean), pure lines of black beans resistant to powdery mildew. The lines are obtained, but experimentation must be done in Haitian conditions to verify their yield potential.

3. from complex crosses between five small-seeded pink or red lines, the ones good yielders, the others disease resistant, to obtain superior lines of small sized pink or red beans.

At the end of these modest breeding work, we hope to be able to give to the haitian farmers the possibility to grow a "superior mixture" avoiding the dangers of genetic uniformity, and allowing to produce red beans for sale without a too large seed investment.

We must apologize for the absence of genetic solution for anthracnose. The most common haitian strains of Colletotrichum belong to the "lambda mutant" race which represent the maximum virulence known today... The best solution for the moment will be the traditional one: the use of seeds produced by the December sowing at sea level, in the absence of rains.

The problem of golden mosaic resistance was too important for our modest team, dispersed between Haiti (without scientific tools), Guadeloupe and Montpelier (France).

SUMMARY

Dry Phaseolus vulgaris beans are a very important part of Haitian people's nutrition. Low soil fertility and leaf diseases are the principal causes of relatively low yields: 0.5 t/ha (however not inferior to the Latino-american average). A minimum phosphopotassic fertilization (0-40-50) plus three fungicide sprays allow to obtain 1.5 t/ha on the same fields. Farmers are able to realize this minimum fertilization (wood ashes supplemented with superphosphate) but cannot buy spraying machines and fungicides.

We have tried to utilize the very important heterogeneity of Haitian germplasm in order to isolate pure lines superior to the average for yielding ability and/or leaf disease resistance, either for direct utilization, or as parents for hybridization and subsequent selection.

The first results obtained and the breeding work in course are described. One of the best haitian pure lines, "Salagnac 86" yields 1.3 to 1.8 t/ha with the minimum fertilization and without fungicides.

But the Haitian tradition of mixing in the field three varietal types (at the least different for development type and seed-size, as an insurance for regular yields and an economy of the amount of seeds to be sown seems to be very wise). Therefore, we go on breeding superior types of medium-sized black beans and small-sized pink beans, in addition to the large-seeded "Salagnac 86" in order to obtain a "superior mixture". We can hope another result: avoidance of genetic vulnerability.