Discourse Journal of Agriculture and Food Sciences
www.resjournals.org/JAFS
ISSN: 2346-7002
Vol. 7(2): 26-30, October, 2019

Influence of mineral and organic fertilizers on pea crop(*Pisum sativum* L.S.) production Under climatic conditions of Congo- Brazzaville

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Abstract

The objective of this study is to improve pea yield and quality of the (local) variety from the use of mineral and organic fertilizers. Four doses, alone or in combination, of nitrogen, phosphorus and potassium were made on pea (local) variety plants. Organic fertilizers were supplied in the form of rotten manure. Protein content in seed, protein collection, and pea yield based on mineral doses were compared to unfertilized plants. NPK and manure intake increased the best yield in 2017. Interactions (N_{25} $P_{30}K_{30}$) and ($N_{12,5}P_{15}K_{15}$) also performed better in 2016 and 2018.The best protein content was observed in 2017 with the use of post effect organic and mineral fertilizers. The combined contribution of mineral and organic fertilizers improves the protein content and yield of the (local) pea variety.

Key words: pea, mineral nutrition, culture, Brazzaville.

INTRODUCTION

Pea, Pisum sativum LS (Fabaceae) is a plant of Asian origin, it is one of the legumes with a huge, largely untapped potential that could secure the world's supply of protein in the future (Kibila, 2000). Peas are also an important protein supplement for cereal and starch products (Cheftel et al, 1985). Pea (local) is produced in several districts of Congo: Bouansa, Loudima, Boko Songho, Madingou, Mfouati in Bouenza. ; Kimongo, Loudela-kayes in Niari. In the districts of Bouansa and Boko Songho, pea is one of the main food crops alongside cassava. It is therefore an important component of the diet and a source of income for farmers. Food legumes have a role to play in addressing malnutrition and food insecurity. For example, in many poor regions of the world, legumes are an important source of human food (beans, peas, lentils, peanuts); fodder (Alfalfa, clover); wood (acacia, dalbergia) and income (Domergue, 2006). Introducing (local) peas into the diet of animals significantly reduces feed consumption, increases animal production and thus reduces its cost. Each tonne of peas introduced into animal feed saves 2.5 tons of concentrated products (Domergue,2006). Improving the elements of crop technology of new pea varieties is the basis for expanding the area of this crop, increasing yields and raw protein costs.

In Congo, this plant species is increasingly appreciated by Congolese who become consumers of its seeds: however, its culture is still marginal. In terms of agricultural policy, only groundnuts, common beans and soya are included in the national agricultural development program (Anonymous, 2008). Pea is grown in traditional cropping systems only to help diversify the family diet (Kinzila, 2009).

In this study, pea yield was determined based on mineral and organic fertilizer rates, and protein content in pea seeds was determined based on fertilizer rates. protein collection.

Material and methods

Plant Material

The plant material consisted of pea seeds of "local" variety. The variety used in this study came from the National Institute for Agronomic Research (IRA), located in the southern zone of the country, in the department of Bouenza. This variety is also distinguished from other varieties by a higher protein content.

Experimental site

The experiment is conducted from 2016-2018 at the Agricultural Technical Extension Center located 17km south of Brazzaville. The center is subject to a low humid tropical climate typical of Congo, characterized by two distinct seasons, namely: - a rainy season from October to May with heavy rains interspersed, a dry season from January to February and a long dry season from June to September (Anonymous, 1989). The average rainfall is of the order of 1200 to 1400 mm of water per year unequally distributed. The vegetation is formed by a savannah composed of a herbaceous layer with Hyparrhenia diplandra (Hack) staff and a shrub layer based on acidophilic shrubs of the species Hymenocardia acida Tull (Anonymous, 1989); -fruit trees such as mango trees, orange trees ..., the soils of the agricultural extension center have a predominantly sandy clay, with a pH ranging between 4 and 5.5. These soils are chemically poor, calcium deficiency. The sum of exchangeable bases is less than 1 mg (Anonymous, 1989).

Methods

Experimental device

The experiment was conducted in the stationary crop rotation of seeds. The structure of the cultivated land in the rotation is as follows: 50% of the cereals, 40% of the plowing, 10% of the beans. The pea was sown in a simple manner with 15 cm spacings and the density per hectare was 1.2 million seedlings. During all the years of research, the local variety of corn precursor pea was sown. The total area is 190.4 m² (5.6m x 34.0m), the extent used is 108m ² (3.6m x 30.0m).

The research was guided by methodological guidelines, according to the methodology of field experiments, on the study of planting techniques of agricultural crops [Dospekhov 1985].

The repetition of the experience is four times; the placement of the cup is systematic.

Use of fertilizers

In this study, research was conducted on five experiments that are most relevant to production.
The planned doses according to the plan of the experiment for the general treatment of the soil are:
1- Control - without fertilizer; (Witness)
2- Minimum dose of complete mineral fertilizers ($N_{12,5}P_{15}K_{15}$);
3- Average dose of complete mineral fertilizers ($N_{25}P_{30}K_{30}$);
4- Organo-mineral fertilizer system (consequence NPK, manure and straw);
5- Fertilization of the pea in the germination phase at the N_{25} dose.

Measured Variables and Data Analysis

Two protein components were measured during the three years of study: protein collection per hectare and protein content in pea seeds based on fertilizer doses. For these two variables, weekly measurements were performed. The mathematical analysis of the results of the experiment showed the presence of a positive dependence between the collection of proteins of one hectare and the yield of peas. All data were statistically analyzed using Statistica version7.1 software.

Results

Table 1 shows the yield of peas (local) as a function of fertilizer doses. Thus, in years of drought and unfavorable for pea cultivation, the efficiency of mineral fertilizers decreased. This regularity was noted in 2016, when the return of negative

Table 1:Pea yield (local) according to mineral fertilizer doses, t / ha

Variation of experience	Year			Average	Control gap
	2016	2017	2018		
Control without fertilizer	1,69	4,08	1,67	2,48	-
$N_{12,5}P_{15}K_{15}$	1,55	4,20	3,22	2,99	+0,51
$N_{25}P_{30}K_{30}$	1,86	4,67	3,00	3,17	+0,69
Repercussion of NPK and manure	1,80	4,69	2,55	3,01	+0,53
N_{25} in fertilization	1,82	4,47	2,30	2,86	+0,38
HCP_{05}	0,11	0,24	0,19		

temperatures at the end of July, as well as at the beginning and mid-August, weakened plant resistance to sedentary lifestyles, which led to a decreased pea productivity on fertilized options after many rains in September. Thus, if on an unfertilised bottom, the yield was 1.69 tons per hectare, then in the variant with the introduction of a minimum fertilizer at the dose (($N_{12,5}P_{15}K_{15}$), there was a decrease of this indicator of 0.14 t / ha or 9.0% (Table 1).

In the other variants of the experiment with fertilizers on the yield, figures of an order of 1.80-1.86 t / ha were obtained. According to the variants of the experiment, they were 11.0-35.1%. However, fertilizer efficiency was higher in 2017 than in 2018. The use of minimum ($N_{12,5}P_{15}K_{15}$) and medium ($N_{25}P_{30}K_{30}$) fertilizer doses provided an increase of 0.07 to 0.15 t / ha or 3,4-7,4%, and the use of the organomineral monitoring system and the introduction of N_{25} in shoot fertilization-from 0.62 to 0.68 t / ha or from 30.8 to 33.6%. The maximum pea yield for all years of study was observed in 2017, when there was enough moisture in the soil during plant growth, as well as the optimal air temperature in March and April, when formation and development of reproductive organs occurred, was optimal ($+30^0$+ 32^0 C).

Seed harvest in the no-fertilizer variant was 4.08 t / ha, which exceeded the average of 72.8% in three years. The maximum yield in 2017 was observed for the variants with an average fertilizer dose (4.67 t / ha) and the effect of organic and mineral fertilizers (4.69 t / ha). The abrupt change in vegetation conditions, which occurred in 2018, with only 1000 mm of rainfall in March and 1180.7 mm in April, resulted in a different reaction of plants to the fertilizer rates used.

In the variants with a minimum ($N_{12,5}P_{15}K_{15}$) and average ($N_{25}P_{30}K_{30}$) fertilizer, the yield was respectively 3.22 t / ha and 3.00 t / ha, which exceeded the control of 92, 8% and 79.6%. The use of the organic and inorganic fertilizer effect and the introduction of nitrogen fertilization (N_{25}) at the beginning of the vegetation were less efficient and the yield increase on these variants was 0.88 t / ha. 0.63 t / ha or 53.6% and 37.7%.

On average, in three years, the use of fertilizers had a positive effect on the formation of higher seed yields than the non-fertilizer alternatives, where this rate was 2.48% t / ha. The use of a minimum rate of fertilizer provided an increase in yield of 0.51 t / ha on average over the years of study. The increase of this dose twice ($N_{25}P_{30}K_{30}$), as well as the use of the post-organomineral system effect, contributed to a further increase in yield, compared to the minimum dose of fertilizer and the introduction of fertilization at nitrogen (N_{25}) on the shoots.

In general, based on experience, the use of fertilizer has contributed to the increase in pea grain over the years studied. Thus, if in the control variant, the variation of this indicator was maximal (V = 48.9%), then with the improvement of the mineral nutrition, the yield of the seeds was leveled (on the fertilized variants, the rate variation was 43.1 to 41.0%). The lowest variation of this indicator was observed in the variants using the effect of organic and inorganic fertilizers (V = 42.5%) and with the introduction of nitrogen fertilization (N_{25}) on the shoots against the background. average soil phosphorus and potassium supply (V = 41.0%).

In our study, on average, in three years, the protein content in pea seeds on a bottom without fertilizer was 22.5%. The use of a minimum rate of fertilizer ($N_{12,5}P_{15}K_{15}$) increases the protein content in the seed by 0.3% and the introduction of a double dose of mineral fertilizer ($N_{25}P_{30}K_{30}$) of 1.5% . The highest protein content in pea seed was in the context of the post-fertilizer effect of organic and mineral fertilizers-24.5%, which exceeded the control of 2.0% (over the years, the protein content of this variant was 20.6-27.7%).

The lowest protein content was in the seed grown in 2018, characterized by a high hydrothermal level during maturation of pea seeds. According to experience, this figure was 18.7 to 21.3%, which was 2.4 to 4.1% below the average. It should be noted that this year, the lowest protein content was observed in the variant with a minimum dose of mineral fertilizer ($N_{12,5}P_{15}K_{15}$), which is obviously the result of the "dilution" effect, The same variant yielded the highest yield this year - 3.22 t / ha. Table 2 shows protein content and pea seed yields.

N.B: 1 - The protein content,%; 2-the collection of proteins t / ha.

In 2017, hydrothermal conditions during seed ripening favored production with maximum protein content. In 2016, the rate varied between 25.6 and 27.7% depending on the experiences. In all cases, the fertilizer doses used contributed to

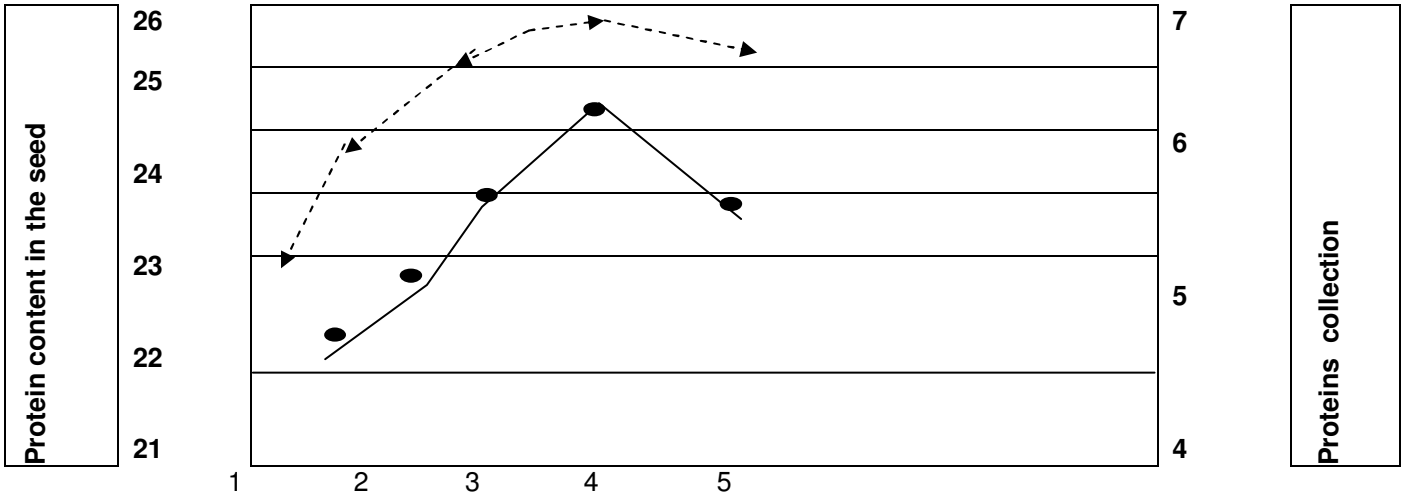
Table 2:The protein content in pea seeds and its harvest according to fertilizer doses, 2016-2018, t / ha.

Variation of experience	2016		2017		2018	
	the protein content,%;	the collection of proteins t / ha.	the protein content,%;	the collection of proteins t / ha.	the protein content,%;	the collection of proteins t / ha.
Control without fertilizer (control)	25.6	0.425	20.8	0.849	20.1	0.356
$N_{12,5}P_{15}K_{15}$	26.0	0.415	22.5	0.945	18.7	0.602
$N_{25}P_{30}K_{30}$	26.7	0.500	24.6	1.149	20.1	0.621
Repercussion of NPK and manure	27.7	0.500	24.2	1.135	20.6	0.525
N_{25} in fertilization	27.5	0.478	23.7	1.059	21.3	0.490

increase the protein in the seed from 0.3 to 2.1%. The most effective was the variant using the effect of organic and mineral fertilizers, where the protein content in the grain compared to the non-fertilizer variant increased by 2.1%. The protein content in the seed of the 2017 crop, according to the variants of the experiment, was at an average level of 20.8-24.6%. The fertilizer doses used increased this figure to 1.7-3.8%.

For crude protein products per unit area, this figure was dependent on both the protein content and the total crop of the seed. The mathematical analysis of the results of the experiment showed the presence of a positive dependence between the protein collection of one hectare and the yield of the peas (r = 0.97 + 0.14), as well as between the protein content in the grain-r = 0.96 + 0.15.

The fertilizer doses used increased the average crude protein collection in three years by 12.2-36.2%, compared to its value in the reference variant of 0.558 t / ha. The maximum protein productivity was different from the introduction of an average fertilizer dose ($N_{25}P_{30}$ K_{30}) - 0.760 t / ha and the use of the organo -mineral system of the post-effect-0.737 t / ha (Figure 1).



- Protein collection ----- • ---- Protein content in the seed,%

Figure 1: Protein harvest per hectare and protein content in pea seeds based on fertilizer doses (average for 2016-2018).

DISCUSSIONS

Numerous bibliographic data [Fedotov, 1980, Priachnikov, 1983 and Tishchenko, 1978], show that the use of mineral and organic fertilizers used directly under peas and under the previous crop in the rotation of crops, greatly increases the harvesting of crops. peas. However, the effect of fertilizers depends largely on the weather conditions of the year. Thus, according to the results of our study, the use of fertilizer provides an increase in the crop, which, depending on the experience options, is determined by the weather conditions of a given year. The highest average yield over three years

and separately over the years, the options with a medium dose ($N_{25}P_{30}K_{30}$) and with the use of the organomineral system (NPK post-effect and manure) are distinguished. According to Pesola (1987), weather factors affect the quality of pea beans more. A similar trend has been observed in our experiments. In some years, the variation of this indicator for experiment variants was 3.4 to 6.6, and the impact of weather conditions resulted in a greater value of the coefficient of variation for the protein content in the experiment. seed. According to the variants of the experiment, it was 10.6-13.6%.
The results obtained made it possible to highlight the minimum dose of the complete mineral fertilizer ($N_{12,5}P_{15}K_{15}$) and the average dose of the complete mineral fertilizer ($N_{25}P_{30}K_{30}$) to determine the dynamics of accumulation of dry substance by the local pea variety plants. Our results coincide with those of Nondah (2004) who observed the highest protein content in the seed during the full maturity period. Organic matter in the form of semi-rotten manure plays many roles in improving or maintaining the physical qualities of the soil, in its ability to store water reserves, in the development of microbial life (Rouanet, 1986). For Dupriez et al. (1983) reviewed by Swift et al. (1987), organic manure, such as animal manure, provide nutrients to the soil while improving its structure. The combination of the residual effect, NPK fertilizer thus makes it possible to obtain the best results of the average daily increment of substance at the beginning of the vegetation (from germination to bud formation) on the plants (Geslin, 1997).

Conclusion

1. The use of fertilizer in pea plantations provides an increase in yield. The highest average yield in three years per year was attributed to the variants with an average fertilizer dose ($N_{25}P_{30}K_{30}$) and with the use of an organomineral system of postffect (NPK and manure station).
2. The use of an average dose of mineral fertilizer ($N_{25}P_{30}K_{30}$), as well as the use of the organomineral system effect, maximize the effect on the improvement of grain quality and protein productivity of crops in years with favorable and extreme weather conditions. There is a slightly less effective variant with the supply of spring nitrogen (N_{25}) on the shoots. The effectiveness of the minimum rate of mineral fertilizer ($N_{12,5}P_{15}K_{15}$) depends largely on the weather conditions of the growing year of pea plants.
The interest of the study scientifically and economically.

References

Anonymous. (1989). Main enemies of cowpea and their control. Canadian Nigero Plant Protection Project, Phase 5, p.42

Anonymous.(2008). Operational Framework for the Implementation of the National Program for Food Security (NPFS) 2008-2009. Ministry of Agriculture and Livestock. Brazzaville Congo. p.40.

Cheftel JC, Cuq JL, Lorient D (1985).Food proteins: Biochemistry, functional properties. Nutritional values. Chemical modifications. Edition Lavoiser.Technique and Documentation: p.309.

Domergue Odile, (2006). Diversity of Rhizobia associated with Onomisrepens: a legume adapted to Mediterranean environments. Memory. Practical School of High Studies: p.87.

Dospekhok B.A , (1985). Method of field experiment.-Kolos, p 317-344.

Dupriez, De Leener P (1983). Tropical agriculture in an African peasant environment. Earth and Life, The Harmattan, p.280

Fedotov RS (1980). Peas.- M: Agricultural Publication, p. 259.

Geslin JD (1997). Soil conservation and rehabilitation. Africa Agriculture, No. 244: 48-55.

Kibila Mayindou AF (2000). Characterization, evaluation and conservation of some common bean cultivars (Phaseolus vulgaris L.) under the pedoclimatic conditions of Brazzaville. Graduation thesis Brazzaville: 48p

Kinzali F (2009).Characterization of some varieties of vigna unguiculata (L) walp in the pedoclimatic conditions of Nkouo. Master's thesis at the end of training for the diploma of rural development engineer, Marien Ngouabi University, Institute of Rural Development (IDR), Brazzaville, Congo, p.56.

Nondah T (2004). Contribution to the strategy of selection of chilli genotypes (Capsicum annum, L) adapted to tropical hot and humid conditions. Master thesis for the Agronomy Engineer Diploma, National School of Agriculture, Senegal, Dakar, p. 71.

Prianichnikov D.N, (1983). Agrochemicals.- M: Agricultural Publication. p.200.

Pesola VA (1987). On the breeding of the field and its results.- At the department of plant breeding, agricultural research center, jokioinen. Helsinki.

.Rouanet G (1986). Maize. The tropical agriculture technician. Editions Maisonneuse and Larose, p.142.

Swift MJ, Lavelle P (1987). Biological process and fertility of tropical soils. ProgRech.Coop. Proposed by the Union of Biological Sciences and MAB / UNESCO, 52p.

Tishchenko AN (1978).Agricultural Technique of Peas in the Black Lands Region.- M: Agricultural Publication, p. 20.