

Forage pea yield after application of different rates of pig and cattle manure

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Abstract

Animal production should be mostly based on farm resources as this reduces animal product costs. Forage legumes like peas are adequate for fulfilling part of the animals' protein needs. Fertiliser prices have also added to high input costs for farmers in recent years, and this makes the use of manures produced on farms more important. This study aims at evaluating the effect of two different rates of pig and beef cattle manure on forage pea yield, compared with the traditional mineral fertiliser used in the area. An analysis of the manures was carried out showing that pig manure has a higher level of nutrients than cattle manure. Both manures resulted in a higher seed yield than was obtained by using mineral fertiliser.

Keywords: fertiliser, protein, production, management, legumes

Introduction

Galicia (NW Spain) is the main Spanish region for the production of milk and meat. This region is located in the Atlantic region of Europe. However, compared with the northern European Atlantic regions, Galicia has a drought period of around two months in summer. This makes it necessary to feed animals indoors during the summer, using silage (mainly maize silage) and concentrates. The protein supply in the feed for animals is the main factor determining the price of concentrates (Heuzé *et al.*, 2013). Increased legume yield in European farms should be promoted in order to reduce production costs, and also because of the environmental impact attributed to the use of soybean imports mainly from America. Legume yield depends on fertiliser supply; this is mainly just P and K on acid soils, as legume crops are able to fix nitrogen from the atmosphere. Due to the high density of pigs and dairy cattle, the amount of manure produced per farm in Galicia is high. This makes it necessary to provide adequate disposal for this residue. The aim of this paper was to evaluate the effect of two different rates of pig and beef cattle manure on the yield of forage pea, compared with using the traditional mineral fertiliser of the area.

Materials and methods

The experiment was established in Goo (NW Spain) in 2014 when the soil was ploughed and the experimental plots were established. Each plot occupied 9 m² and in June 2014 the plots were sown with forage peas. The experiment followed a randomized complete block design with four replicates and five treatments. Initial soil analyses are listed in Table 1. Soil pH was very acid as is usual in the area. The levels of nutrients and heavy metals were low.

The treatments consisted of two rates (low (L) and high (H)) of two types of fertilisers (pig manure (P) and cattle manure (C)). The total amounts of manure added were 27.24 and 54.48 Mg ha⁻¹ for the low and high rates of fresh cattle manure, and 37 and 74 Mg ha⁻¹ for low and high rates of the pig manure. Therefore, these rates supplied 61 and 123 kg N ha⁻¹, 13.8 and 27.8 kg P ha⁻¹ and 84 and 168 kg K ha⁻¹ when the cattle manure was applied, and 27.6 and 55.1 kg N ha⁻¹, 16.6 and 33.3 kg P ha⁻¹ and 30.1 and 60.2 kg K ha⁻¹ when pig manure was used. These are actual values based on samples taken while the fertilisation was being carried out at field level. The quality of the both types of manure is presented in Table 2. Pig manure has a lower amount of dry matter, higher concentrations of nutrients and also a

Table 1. Initial soil analyses. All concentration values are on a dry matter basis.

pH (H ₂ O)	pH (KCl)	N (g kg ⁻¹)	P (g kg ⁻¹)	K (g kg ⁻¹)	Na (g kg ⁻¹)	Ca (g kg ⁻¹)	Mg (g kg ⁻¹)	Fe (g kg ⁻¹)	Cr (mg kg ⁻¹)	Cu (mg kg ⁻¹)	Mn (mg kg ⁻¹)	Ni (mg kg ⁻¹)	Zn (mg kg ⁻¹)
5.26	3.84	0.8	1.2	5.9	1.1	3.2	14.3	30.7	3.61	15.79	41.19	29.78	125.32

Table 2. Properties of cattle and pig manure used in this experiment. All concentration values are on a dry matter basis.

	Dry matter (%)	N (g kg ⁻¹)	P (g kg ⁻¹)	K (g kg ⁻¹)	Na (g kg ⁻¹)	Ca (g kg ⁻¹)	Mg (g kg ⁻¹)	Fe (g kg ⁻¹)	Cr (mg kg ⁻¹)	Cu (mg kg ⁻¹)	Mn (mg kg ⁻¹)	Ni (mg kg ⁻¹)	Zn (mg kg ⁻¹)
Cattle manure	10.19	22.1	5	30.3	1	9.8	8.2	2.1	1.7	15.65	9.6	2.35	61.2
Pig manure	2.38	31.3	18.9	34.2	2.7	18.3	2.51	2	3.55	162.2	11.35	8.65	1,266.29

higher concentration of heavy metals compared with cow manure. Mineral fertilisation (MIN) consisted of inputs of 40, 52.8 and 66.4 kg of N, P and K per hectare in the form of mineral compound 8:24:16.

To estimate the yield of forage peas, in each plot a surface of 2.5×2.5 m² was harvested and weighed in the field in October 2014. Before the harvest, the crop establishment rate in each plot was determined by visual estimation. In the laboratory, a subsample was separated into the components of pod, stem and seeds. These components were dried and weighed to estimate the dry matter yield and the dry matter weight of 100 peas. Data were analysed using ANOVA and differences between averages were shown by the least significant difference (LSD) test, if ANOVA was significant. The statistical software package SAS (2001) was used for all analyses.

Results and discussion

The establishment of the crop (Figure 1) was quite adequate considering the yield that the forage crop reached (between 8 and 9 Mg ha⁻¹), which is within the usual range for forage peas (Bilgili *et al.*, 2010; FAO, 2012). However, the total yield was significantly increased by the use of manure, both pig and cattle (5.05, 8.36, 9.71, 9.64, 8.59 Mg ha⁻¹, respectively for MIN, PL, PH, CL, and CH). The differences between treatments were mainly linked to the different amounts of seed yield. Seeds were better developed when manure was used, as indicated the variable of weight of 100 seeds. No differences between rates or type of the organic fertiliser were found. The results can be explained by the action of the manure in supplying a wider range of nutrients and organic matter than the mineral fertiliser. This could avoid the negative effect of the Al content in the soil due to the addition of Ca and also the inputs of organic matter, which could retain Al and release it from the soil nutrient solution. The lack of differences in the effects of manure rates makes us recommend using the low manure rate, whether it comes from cattle or pig farms. Similar results were also found by Olusegun (2014).

Conclusions

The use of manure, both cattle and pig manure, caused a higher seed yield when compared with using mineral fertiliser. Therefore, the use of manure at low rates will allow farms to be more sustainable and profitable from an economic point of view.

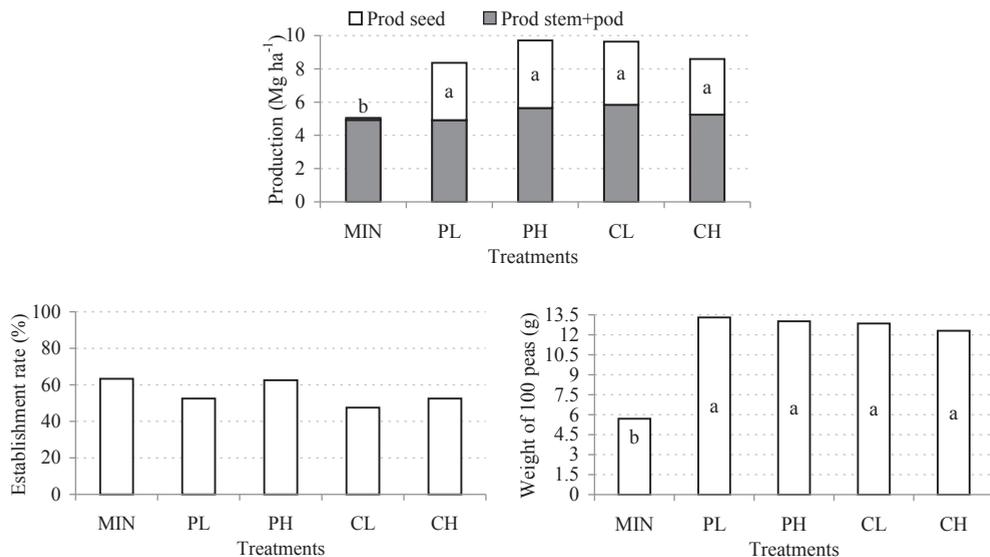


Figure 1. Yield per seed (Prod seed) and stem + pod (Prod stem + pod), establishment rate and dry matter weight of 100 peas in the different treatments. MIN: mineral fertilisation; PL: pig manure at low rates; PH: pig manure at high rates; CL: Cattle manure at low rates; CH: cattle manure at high rates. Different letters indicate significant differences between treatments.

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