Journal of Soil Science and Environmental Management Vol. 1(9), pp. 243-245, December 2010
Available online at http://www.academicjournals.org/JSSEM
ISSN 2141-2391 ©2010 Academic Journals

*Short Communication*

# Changing weather and introduction of pigeon pea intercrop in formerly cold pyrethrum zone

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Accepted 25 November, 2010

**Pyrethrum is a, herbaceous perennial crop grown commercially for extraction of pyrethrins, which is used in pesticides formulation. Through out the years, it has been grown in a pure stand due to its poor performance as intercrop with other crops that do well in pyrethrum growing areas. A trial was carried out on introduction of a short pigeon pea variety at different line spacing within the pyrethrum crop in randomized complete block design replicated four times. Data on dry pea yields was analyzed using ANOVA and fitted in a generalized linear model, with the distribution assumed to be Gamma and a link function as inverse. The results showed that there was a significant difference ($F_{(4, 132)} = 4.76$; $p=0.001$) among the intercropping levels of pyrethrum and pigeon pea. The control (pure stand of pigeon pea had the lowest yield (0.92 t ha$^{-1}$) as compared to 1:1 intercropping of pyrethrum and pigeon pea which had the highest pigeon pea yield (1.12 t ha$^{-1}$). Comparison of pigeon mean yield showed that there were significant differences ($p<0.05$) between control and 1:1, 2:1 and 3:1 intercropping. However, there were no significant differences ($F_{(1, 132)} = 2.68$; $p=0.104$) between control and 4:1 intercropping of pyrethrum and pigeon pea. Overall no significant differences ($p>0.05$) in pigeon pea yields were found among all intercropping spacing. These findings indicated that pigeon pea might be a good option to inter crop with pyrethrum. Further monitoring and assessment would be carried out to assess both pyrethrum and pigeon pea yield at different seasons of the year. It was observed that means of the rows were significantly different with pigeon pea pure stand giving the lowest. This observation indicated that pigeon pea is a good option to inter crop with. In all spacings the pigeon pea performed well. If interest would be the quantity of pigeon pea then 1:1 spacing would be resulted to.**

**Key words:** Field productivity, soil microbial symbiotic association, soil nutrient availability.

## INTRODUCTION

Pyrethrum is an herbaceous perennial crop grown commercially for extraction of pyrethrin, which is used in pesticides formulation. Pyrethrum has been forth foreign exchange earner in Kenya. Kenya has been the highest producer of pyrethrum in the world. More than 90% of pyrethrum is grown by small-scale farmers. When the world market is good, and often is the case, farmers opts to plant his small piece of land purely with pyrethrum. The main pyrethrum growing areas formerly used to be cold highland where maize and beans would do poorly. Due to continuous climatic changes which has been caused mainly by, global warming, the same areas appear capable of growing some selected varieties of pigeon peas also. To increase soil productivity, pigeon pea (*Cajanus cajan*), a leguminous perennial crop was evaluated for its potential as a short crop for intercropping with pyrethrum. It has been uneconomical to inter-crop pyrethrum with other local food crops. When planted together it will be one of the two but not both that survives. Some of the crops, such as maize and potatoes, that would be planted with pyrethrum are tall and would lead to shading over pyrethrum. Any amount of shading to, this crop that would rarely reach a height of 1 m usually has adverse effect on its growth.

This effect often can lead to total loss of the whole pyrethrum crop. The shorter crops like garden peas and

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beans do not survive the nutrient and water competition by pyrethrum. Pyrethum is generally a heavy feeder with most roots growing between, 0 to 20 cm deep. The small scale farmers have limited piece of land to plant both pyrethrum as cash crop and other subsistence crops. Pigeon pea opted for has an advantage in that it is a short variety, and at the same time it is deep rooted. Pigeon pea does well over pH of 4.5 to 8.5, as compared to pyrethrum growing areas in the country are range between, pH of 4.5 to 6.5.

The pigeon pea is known to have high nutritional value when used as food crop, and besides it can fetch ready market locally. It fixes nitrogen through symbiotic association with nitrogen fixing bacteria. From the In contrast from analysis done at in the pyrethrum trials at the research center by the first author, it has been observed that, pyrethrum has a high requirement of nitrogen. Nitrogen application is not recommended and hence this intercropping would possibly enhance availability of the much needed nitrogen. Mychorrhyzal association is known to exist in the plant rhizosphere, (shibata and Yano, 2003; Yano et al., 1998). Certain non-labile forms of P such Ca-phytate can be dissolved by its roots xudates. The association also can improve availability of zinc in pigeon pea (Wellings et al., 1991). From observations of pyrethrum nutrient trials by the first author it was noted that uptake of zinc can go up to 1kg per ha. At one time a field formally occupied by tea, was noted to have very poor performance by pyrethrum and the low zinc in the field was queried. These can lead to higher availability of certain nutrient as phosphorus to the plant. The mycorhyza can be associated with stability in soil structure (Miller and Kling, 2000). Another possible benefit is the control of the common soil pest in pyrethrum, the nematode. Garrido et al. (2008) indicates the potential of pigeon pea and clotalaria in the control of nematodes. One of the interests in this initial trial was to observe the behavior of pigeon peas at Molo altitude of about 2400 m above the sea level. Also observed was performance of the pigeon peas when planted within the rows of pyrethrum. This would act as a foundation to further work to be done later in pyrethrum growing areas.

## MATERIALS AND METHODS

Pyrethrum was established through almost uniform splits. In the trial, plots of pyrethrum were planted in sizes of 15 plants by 11 rows. Inter-row spacing was 60 cm and intra-row spacing of 30 cm, where these are the recommended spacing. Clonal material used was L/75/477. Triple Super phosphate was used at the rate of 220 Kg per ha. This is a recommended rate which is based on the uptake rather than the performance. Normal agronomic practice such as, weeding and gapping, was maintained. The crop was left to establish before the pigeon pea intercrop was introduced. This was about 3 months.

For pure crops pigeon pea should be sown 2.5–5 cm deep in rows 40–120 cm by 30–60 cm. When sown as a mixture, it should be sown in widely spaced rows ranging from 1.2–2.1 m depending on the associated crop. About 3–4 seeds may be planted in each hill, and later thinned to 2 plants per hill (James, 1983). On the other hand pigeon pea had an in intra-row spacing of 30 cm. Pigeon pea variety, ICPL 8709, was used. This is a short variety and in the inter-planting, was planted within the normal spacing of pyrethrum rows. The pyrethrum/pigeon pea rows intercrop was laid out in four levels: pure pigeon pea stand, 1:1, 2:1, 3:1, and 4:1. The treatments were replicated four times in randomized complete block design. Pigeon peas were picked when they were dry. After exposing them to sun drying until completely dry, data on the peas' weights was taken from each row of the plants. The yield from the net plot area was converted into t per ha and analyzed using ANOVA and a generalized linear model with a distribution as gamma and link function as inverse. Orthogonal contrasts were used to compare significant differences among treatments. The statistical significant differences were declared at 1 and 5%, unless stated otherwise. All data were entered in micro soft excel 2003 and analyzed using General statistics version 10 (Genstat V10) statistical software.

## RESULTS AND DISCUSSION

The results showed that there were significant differences ($F_{(4, 132)} = 4.76$; $p=0.001$) among the intercropping levels of pyrethrum and pigeon pea. Pure stand of pigeon pea had the lowest yield (0.92 t $ha^{-1}$) as compared to 1:1 intercropping with pyrethrum, which had the highest pigeon pea yield (1.12 t $ha^{-1}$; Table 1). Comparison of pigeon mean yield showed that there were significant differences ($p<0.05$) between control and 1:1, 2:1 and 3:1 intercropping. However, there were no significant differences ($F_{(1, 132)} = 2.68$; $p=0.104$) between control and 4:1 intercropping of pyrethrum and pigeon pea (Table 2). Overall no significant differences ($p>0.05$) in pigeon pea yields were found among all intercropping spacing. Each of the pigeon pea rows had 15 hills, resulting to 55,000 hills per ha. The significant difference in pigeon pea mean yield among treatments was mainly as a result of control. The non-significant statistical differences among intercropping ratios of pigeon pea and pyrethrum showed that any of those ratio spacing was equally likely to produce the same pigeon pea yield. This further demonstrated that the symbiotic association between pyrethrum and pigeon pea with little negative effects on pigeon pea yield. In addition this implied that with successful completion of monitoring and assessment of the trials at different growing seasons compounded with climate data, small scale farmers would be able find a suitable inter spacing of pigeon pea with pyrethrum. This result corroborates well with James (1983) who found that the yields of dried seed were ranging between 0.6 to 2.5 t/ha. Varshney et al. (2009) also found that the average crop productivity of pigeon pea was 0.78, in India.

## Conclusion

This initial work indicates that incorporating pigeon pea into pyrethrum field is viable and capable to provide both food and financial gains to the farmer. Pigeon pea has a ready market locally due to its nutritional value, and its

**Table 1.** Mean yield (t $ha^{-1}$) of pigeon pea under different interspacing ratios with pyrethrum at Molo.

| Treatment | Mean yield (t $ha^{-1}$) | N |
|---|---|---|
| Pure stand of pigeon pea | 0.9 | 44 |
| Pyrethrum and pigeon pea in 1:1 | 1.1 | 44 |
| Pyrethrum and pigeon pea in 2:1 | 1.1 | 24 |
| Pyrethrum and pigeon pea in 3:1 | 1.1 | 16 |
| Pyrethrum and pigeon pea in 4:1 | 1.0 | 12 |
| s.e.d | 0.0763 | |

**Table 2.** Mean comparisons of pigeon pea under different interspacing ratios with pyrethrum at Molo.

| Source of variation | d.f. | m.s. | p-value |
|---|---|---|---|
| Replication | 3 | 0.12382 | |
| Treatment | 4 | 0.26095 | 0.001 |
| Control versus 1:1 | 1 | 0.93207 | <.001 |
| Control versus 2:1 | 1 | 0.47335 | 0.004 |
| Control versus 3:1 | 1 | 0.26668 | 0.029 |
| Control versus 4:1 | 1 | 0.14697 | 0.104 |
| 1:1 versus 2:1 | 1 | 0.01516 | 0.6 |
| 2:1 versus 3:1 | 1 | 0.00545 | 0.753 |
| 3:1 versus 4:1 | 1 | 0.0046 | 0.773 |
| Residual | 132 | 0.05486 | |
| Total | 139 | | |

domestic uses. There has been occasional extended draught, during when the farmer can leap from his field through the pigeon peas, this when pyrethrum is dormant and unproductive. More work needs to be done, to observe variations in different pyrethrum growing zones. Also mutual gains as observed in 1:1 plots need to be further observed and quantified. Within pyrethrum cultivars there are certain differences between clones and varieties. There will be a need to observe variation of this response between pyrethrum clones and varieties. There is information on potential of pigeon pea to the control of nematodes. Since nematode is a major soil pest in pyrethrum, this interaction will be beneficial to a pyrethrum farmer. Long term effect on intercropping needs to be observed, with a view that all ratios gave an increase in productivity though at different quantities. Application of nitrogenous and phosphorus fertilizers, in planting pyrethrum, adversely affects establishment of pyrethrum. This has an impact in the later life of the field. Due to the presence of mycorhyzal association and nitrogen fixing bacteria in the pigeon pea rhzosphere, the inter-crop stands impart these beneficial effects to the performance of pyrethrum crop.

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