17 e 20 de setembro de 2012
Uberlândia-MG-Brasil

XXV Congreso de la Asociación Latinoamericana de la Papa - **ALAP**
XIV Encontro Nacional de Produção e Abastecimento de Batata - **ENB**

PEST INTENSITY-CROP LOSS RELATIONSHIPS FOR THE LEAFMINER FLY *LIRIOMYZA HUIDOBRENSIS* (BLANCHARD) IN DIFFERENT POTATO (*SOLANUM TUBEROSUM* L.) VARIETIES

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Introduction

The leafminer fly *Liriomyza huidobrensis* (Blanchard) is one of the most damaging pests of potato. Damage is caused by leaf punctures of females for either oviposition or apparent feeding, and by larvae mining in the leaf mesophyll, which can reduce the photosynthetic activity of the mined leaf area. Potato varieties are differently affected and the longer the crop maturation time the lower the damage and yield loss, probably due to the ability to better recover lost foliage (Mujica and Cisneros 1995; Midmore 1981) Also, the phenological growth stages in which pest infestation occurs have shown to play a predominant role in the amount of defoliation potato can tolerate before yield losses occur (Midmore 1981; Ziems *et al*. 2006). Potato plants are able to tolerate higher amounts of defoliation during tuber initiation and crop maturity than at full bloom. Knowledge of the relationship between foliar damage and yield loss is essential for the integrated management of the leafminer fly. The objective of this research was to evaluate the effects of foliar damage on potato yield which is caused by natural populations of the leafminer fly *L. huidobrensis* at different growth stages and to establish economic control thresholds for potato varieties with different maturation times.

Materials and method

Field experiments were carried in the Canete Valley, Peru during the potato cropping season from July to November in the years 2005, 2007 and 2008 using early (Desiree, Revolucion, Maria Tambeña), middle-late (Canchan, Tomasa) and late (Capiro and Yungay) maturing potato varieties. Data of foliar damage and yield were subjected to analysis of variance and functional correlations were calculated with intensity of infestation (percentage of foliar damage) as the independent variable (X) and yield as the dependent variable (Y). Critical Point and Multiple Point Models were used to establish yield functions in relation to the intensity of infestation at various growth stages. The model which best described the relation between foliar damage and yield was used to estimate the pest intensity–crop loss relationship. The base yield calculated from these models was used as a reference for estimating yield losses and deriving the pest intensity crop loss relationship (b_1) for each variety. The economic control threshold (ECT) was calculated as $ECT = C/p\ E\ b_1\ K$, where C equals control costs, p is the product price in $/t, E is the normal yield without infestation in t/ha, b_1 is the pest intensity-crop loss relation in %, and K is the expected success of a control measure.

Results

Seasonal variation of the leafminer fly flight activity in each year of evaluation affected the intensity of foliar damage and consequently the final yield in all potato varieties. Yield losses in untreated plots reached 51% (3147 adult/trap/season) in 2005, 0% to 22% in 2007 (2508 adults/trap/season) and 17% to 45% in 2008 (2164 adults/trap/season). Foliar infestation increased during the development and growth of the potato plant with highest damage at the end of the cropping period. In untreated plots, early varieties reached a foliar damage of 78% (Desiree) and between 54% and 80% (Revolucion 2007-2008) at crop maturity. By contrast, the foliar damage of late varieties was 22% (Capiro) and 41% (Yungay) at the same growth stage. One exception made the early variety

María Tambeña with a foliar damage of only 38%, a variety which is considered partially resistant to leafminer fly. The pest infestation-crop loss relationships indicated that the accumulated foliar damage up to the flowering (GS60) and berry formation stage (GS70) produced the highest yield losses in most of the potato varieties; for the early variety Desiree it was the bud formation stage (GS50). Economic control thresholds varied according to control costs and commodity values in each potato variety. A foliar damage of 21% to 28% at GS50 (Desiree), 34% to 37% at GS60 (Revolucion), 31% to 41% at GS70 (Canchan), 40% to 53% at GS70 (Maria Tambeña), 55% to 74% at GS75 (Tomasa) and 40% to 54% at GS60 (Yungay) were estimated as ECT for leafminer fly management in the different varieties. Under our experimental conditions, only untreated plots of the early varieties Desiree and Revolucion and the middle-late variety Canchan reached a foliar damage at the specific growth stages which was above the established ECT. In insecticide treated plots those varieties reached a mean foliar damage of 1% to 10%.

Discussion

Early potato varieties had a higher mean foliar damage than late potato varieties which resulted in higher yield losses. Most potato varieties, but particularly late-maturing varieties are able to produce new leaves and have more time to recover initial leaf damage which has less long-term repercussions on yield (ZIEMS *et al*. 2006; IRIGOYEN *et al.* 2011). The determined leafminer fly infestation-crop loss relationships showed that the foliar damage accumulated up to the potato crop stages of bud formation (GS50) and formation of berries (GS 70) resulted in the highest yield losses in all potato varieties. Similar consequences on yield losses through natural and accumulated infestations are described for the potato tuber moth, *Phthorimaea operculella* (Zeller) (KROSCHEL, 1995). IRIGOYEN *et al.* (2011) used artificial defoliation of potato and found that flowering (GS60) was the most sensitive growth stage affecting potato yields. The physiology of the potato plant and the reallocation of resources from the leaves to tubers explain the importance of a healthy leaf area at this crop stage. In our study, the estimated ECT values varied for the different potato varieties. The late maturing varieties generally compensated better higher damage levels and hence ECT values were higher compared to early maturing varieties. The study demonstrated that potato varieties can tolerate considerable levels of foliar damage by *L. huidobrensis* and pre-emptive insecticidal control is economically not justified until foliar damage exceeds these values.

Conclusion

For potato production systems of the Peruvian coast, which are affected by the leafminer fly, *L. huidobrensis*, the use of middle and late maturing varieties is recommended to reduce yield losses. For early varieties an integrated management of the leafminer fly has to be considered applying the established control thresholds and using selective insecticides. The ECT should be used as a decision support tool for managing the leafminer fly to reduce pest management costs. These ECT values provide a good basis for further investigations and applications in other agroecological regions where leafminer fly is also a pest problem.

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