Investigation note

Adoption of corn innovations under the field schools model in Tlalcozotitlán, Guerrero

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Abstract

In order to increase the yield in corn cultivation in Tlalcozotitlan, municipality of Copalillo, Guerrero, technological innovations were implemented under the field schools model (ECA) and its degree of adoption was determined. 30 questionnaires were applied to know the initial situation of the producers, about the yield per hectare with traditional technology. The second phase was the establishment of the corn-school plot and the training of producers; through the ECA model, in the context of producer-promoter training. The variables recorded were performance, cost of production, B/C ratio and the degree of adoption of innovations. The initial situation indicates a yield of 0.9 t ha^{-1} of corn grain, a production cost of $9 457.00 ha^{-1} and a B/C ratio of 0.43, in the school plot 2 036 t ha^{-1} was obtained and a production cost of $11 767.00, increased 1 136 t ha^{-1}, which corresponds to 126% in two years of evaluation and a B/C ratio of 0.79. There were statistically significant differences in the knowledge and adoption of technological innovations by the producer-promoters before and after receiving the training and accompaniment courses of field schools, developed in corn cultivation, where 47% of adoption in selection component was obtained of creole corn and 31% in seed inoculation with mycorrhizae and *Metarhizium*.

Keywords: learn by doing technologies, yield.

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In the state of Guerrero, the cultivation of corn (*Zea mays* L.) occupies the first place among the main basic grains that are produced. In 2017, 439 281 ha were planted under temporary conditions with an average yield of 3 037 t ha^{-1} (SIAP, 2017); it is grown in areas of low, medium and good productivity. Corn has social, cultural and food importance, where agriculture is traditional, without denying the existence of some modern practices. This species faces climatic changes and the uncertainty that affects production due to cultivation practices and local environmental conditions (Munguía-Aldama *et al*., 2015).

The producers of Tlalcozotitlan plant the corn for self-consumption; they face the problem of the availability of water (water stress) and the low production yield due to the incidence of pests such as the bud worm, combined with the low technological level. To reduce the problem and improve the productivity of corn, through a diagnosis: some technological innovations were implemented, through training sessions under the Field Schools model (ECA) for the training of producer-promoters according to the phenological development of the crop (Morales *et al*., 2015).

The adoption of technology is the appropriation of practices and knowledge by producers and consists of awareness, interest, evaluation and adoption of the idea or practice (Ayala, 2008). The present work aimed to promote the increase of at least 20% corn production per unit area compared to traditional production and the degree of adoption of agricultural technologies in producers.

The investigation was carried out in the town of Tlalcozotitlán, municipality of Copalillo, Guerrero, on a producer-promoter plot, located between 17° 52’ 47.13’’ north latitude and 99° 9’ 6.79’’ west longitude, at 580 m from altitude, it has a semi-arid semi-warm climate (BS1hw) Garcia (1988), 600 mm per year and a temperature of 26 °C. 30 interviews with producers were applied to know the production, costs, family income and organization. With the information obtained, innovations were proposed in the spring-summer 2017-2018 cycles. The actions were carried out in seven training sessions (Table 1); through the ECA model by Morales *et al*. (2015), which included a theoretical session, practice, reflections and agreements. With the support of the professional service provider that lived in the community to follow up.

Table 1. Technological components implemented in the corn-school plot in Tlalcozotitlán, Copalillo, Guerrero. 2017-2018 PV cycle.

Stage	Technological innovations
Sowing	1) V-236P (pepitilla) and control Dk® 357, 20 kg ha^{-1}. 62 000 plants, furrows to 80 cm
	2) seed inoculation with mycorrhiza (*Glomus* spp.) and insecticide (*Metarhizium anisopliae*) in doses of 1.5 L ha^{-1}
Organic fertilizers	3) preparation and application of organic fertilizer (*bocashi*)
Fertilization	4) chemistry (1st application in sowing and 2nd in aporque). Urea (46-00-00) and ammonium phosphate (18-46-00)
Pest control	5) installation of pheromone traps and *Trichogramma* sp., for monitoring and control of the bud worm (*Spodoptera frugiperda*)
	6) preparation and application of vegetable extract and mineral broth
Corn selection	7) mass selection method

The yield estimate was made using the methodology proposed by Laffite (1993), the grain weight and yield estimate per hectare with 15% humidity were determined. The data capture in Excel program (2016), the variable of yield (t ha^{-1}), production cost (\$ ha^{-1}) and B/C ratio was obtained. The 'before' (pre-test) and 'after' (post-test) information were described descriptively using arithmetic proportions and means (Briones, 2002).

Adoption of innovations by producers

To document the degree of adoption of innovations by the producers, 30 interviews were applied at the end (after) of the training carried out in the corn-school plot and the information was captured in Excel (2016). Each innovation implemented was assigned a value of 0.5= to simple innovations; 1= moderately elaborated innovations and 1.5= very elaborate and complex innovations for the producer. According to the methodology described by Merino (2018).

$$K_n = \frac{y}{\sum_{1}^{n} x} = Z$$

Where: K_n= percentage constant of innovation domain indicator. $\sum_{l}^{n} x$= number of technological innovations that occurred in the ECA sessions. y= value of each innovation that contributes to the total mastery of technology; Z= value of the indicators of mastery of agricultural technology. Once the contribution of each innovation and the weighting value were defined, the maximum score for each component was obtained to obtain 100% adoption (Table 2).

Table 2. Maximum qualification of the technological components.

No.	Technological innovations implemented with ECA sessions	(%) of each technological innovation
1	V-236P (pepitilla)	14
2	Seed inoculation	7
3	Seed inoculation	14
4	Fertilization	22
5	Sex pheromones Pherocon® and *Trichogramma* sp.	7
6	Vegetable extract and mineral broth	14
7	Corn selection	22
	Total	100

Elaboration obtained from the survey applied to producers.

Statistical analysis was performed with the non-parametric Wilcoxon test. The Statistical Package for the Social Sciences (SPSS) v. 19.0 in Spanish. To test the null hypothesis H_o: it was suggested that the adoption of technological innovations by the producer-promoters does not differ after having received the training and performance courses in corn. The hypothesis H_1: there are statistically significant differences regarding the adoption of technological innovations by the producer-promoters after having received the training and performance courses in corn.

Diagnosis of the current situation of the producer group

It was determined that 100% of the respondents are male, 50% of the producers own common land and the rest of the community with an average of 3.2 ha per producer, 93.3% of the producers are dedicated to agriculture, 6.6% to livestock and they have complementary activities such as day laborers, plumbers and bakers.

100% of the agricultural producers grow corn from which 30% is associated and 70% is monoculture; 60% use creole corn varieties and 40% use improved varieties they receive from productive programs, no producer selects his seed for the next cycle and only 10% practices crop rotation with sesame seeds. For planting corn, 27% use the tractor for the fallow and 77% the yoke, 100% use the yoke to furrow the land; 80% of producers apply chemical fertilizer, 30% use herbicides and control pests.

The production cost of one hectare is $9 457.00. On average they obtain a yield of 0.9 t ha^{-1} of corn grain and a B/C ratio of 0.43, which indicates that they have economic losses due to water stress in the area. The production volume was 2.1 t of corn per family per year in 2.3 ha, of which they consume 1.52 t per family and the rest they use for sale; however, families that only plant one hectare need to acquire 0.62 t per year. Therefore, they sell their animals, fish in the river, borrow, workday laborers, hunt wild animals and get support from social programs.

Implementation of the corn school plot under the field school model

With the implementation of the seven technological innovations in the school plot, 2 036 t ha^{-1} was obtained, corresponding to 126% increase in corn grain yield in two years of evaluation with respect to the baseline survey (Table 3). The result obtained was reflected by the timely monitoring of the activities by the producer-promoter and the support of the technician who lived in the community as part of the technology transfer process of the field school method.

Table 3. Yield, production cost and B/C ratio per ha in the corn-school plot in Tlalcozotitlan, Copalillo, Guerrero. S-S-2017-2018 cycle.

Evaluations/genotype	Yield (t ha^{-1})	Production cost ($ ha^{-1})	Ratio B/C
V-236P (pepitilla)[*]	2.036	11 767.00[1]	0.79[2]
Dk® 357 (Control)	1.107	10 957.00	0.45
Baseline (survey)	0.9	9 457.00	0.43

[*]= innovation component implemented in the corn school plot; [1]= production costs; [2]= income generated for the producer.

Damian *et al*. (2016) with the producer-innovative model (MPI) found that corn producers with low, medium and high productive potential obtain yields of 500 and 2 200 kg ha^{-1} and an average of 1 700 kg ha^{-1} with the implementation of ten innovations. Results similar to that obtained in the present investigation with a group of corn producers in marginalized areas and in situations of extreme poverty.

Degree of adoption of innovations by producers

The Wilcoxon test indicated that all the technological components implemented in corn cultivation had statistically significant differences ($p < 0.01$) in the knowledge and adoption of technological innovations by the producer-promoters before and after receiving the training and accompaniment courses technician under the field schools model (Table 4). Orozco *et al*. (2011) observed significant increases in the level of knowledge of the producers at the end of the training with the ECA regarding the initial evaluation of knowledge on the different training topics.

Table 4. Test of ranges with Wilcoxon signs in the knowledge and use of technological components for producers who participated in the training in Tlalcozotitlán, Copalillo, Guerrero. 2017-2018.

No.	Technological innovations	Statistical Zc	Bilateral Sig.
1	V-236 P (pepitilla)	-4.78**a	0.000
2	Seed inoculation	-4.85**a	0.000
3	Organic fertilizers	-4.82**a	0.000
4	Fertilization	-4.93**a	0.000
5	Sex pheromones Pherocon® and *Trichogramma* sp.	-4.88**a	0.000
6	Vegetable extract and mineral broth	-4.83**a	0.000
7	Corn selection	-5.02**a	0.000
	Average	-4.78**a	0.000

Critical value with normal approximation (Z_{α}) with 0.01= ± 1.73; [a]= It was based on negative ranges, from 30 trained producers. Source: own elaboration.

Figure 1 shows an increase in knowledge and use of technological innovations before and after the training process, where the creole corn selection component had 47% adoption by producers, meanwhile Barros (2017), points out that work must continue; promotion, valuation, use, exchange and conservation of native or creole seeds.

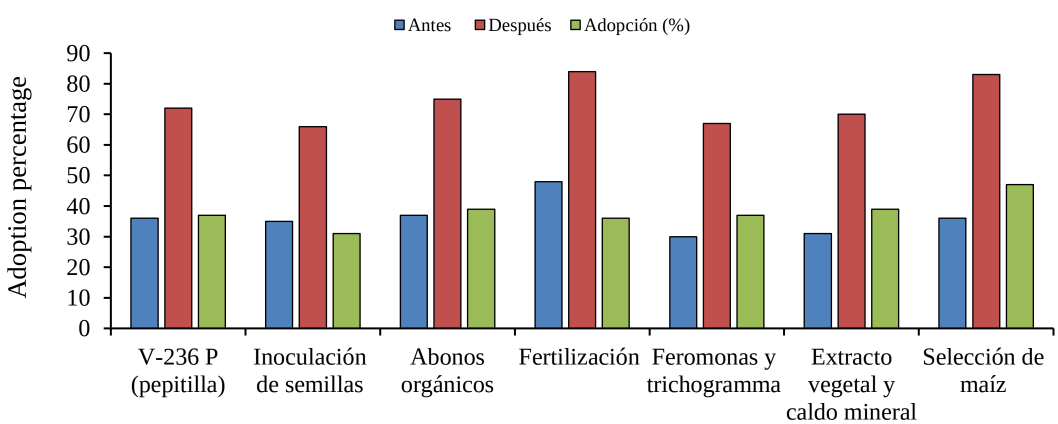

Figure 1. Use of technological innovations and degrees of adoption with corn producers in Tlalcozotitlan, Copalillo, Guerrero.

Orozco *et al*. (2011) found a level of technological knowledge of 7.29% in the producers before the training and 46.64% at the end of the training of field schools, show that the increase in the level of technological knowledge does not increase the food availability of corn. Orozco *et al*. (2009) point out that the peasants with greater participation in the Field School (EC) sessions had greater knowledge and technological adoption compared to those who were not trained.

Mendola (2007) found that the adoption of agricultural technology contributes to the welfare and overcoming of poverty in rural producers. 39% adoption was achieved in the components organic fertilizers, plant extracts and mineral broths, this favored because the majority of inputs for its elaboration is in the community and the cost for its preparation is minimal and family labor is used. López y Lozano (2016) found that the application of organic bocashi fertilizer in the soil significantly increases their fertility, improving organic matter by 2.92%, nitrogen 352 ppm, phosphorus 114.8 ppm and potassium 202.55 ppm, with the application of 40 kg of fertilizer in one 3 m^2 surface.

37% knowledge and adoption of the 236P variety (pepitilla), sex pheromones and *trichogramma*, Kuniyoshi *et al*. (2003) when using pheromones to control and monitor *Spodoptera frngiperda*, they found fewer cobs with worm damage in pheromone plots, resulting in a marginal rate of 83% with respect to not using pheromones. There was only 36% adoption in fractional chemical fertilization, this was mainly due to the fact that this component is already delivered to the producers through the fertilizer program that the state government has.

Conclusions

The seed inoculation component with mycorrhizae and *metarhizium* was less adopted by the producers with only 31%, this component is little known and commercial and its application requires certain care by the producer. The training and dissemination of technological innovations under the field schools model has influenced the increase in corn yield per unit area. The degree of adoption of technologies was good, for the interest of the producers in participating in the training sessions and the timely follow-up of the technician to the producer-promoters.

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