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ON-FARM TESTING OF FYFANON 880 EC (MALATHION, 880G/L) ON THE MAJOR INSECT PESTS OF TOMATO IN THE KOLLO REGION (NIGER REPUBLIC)

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Abstract: Tomato is a major vegetable crop grown in Niger. It is also one of the most infested plants by insect pests. To contribute to the control the pests, a study was conducted to test the effectiveness of Fyfanon 880 EC (Malathion 880 g/l) on the insect fauna of tomato at research station of the Agriculture college of Kollo. This product was compared to Cypercal (cypermethrin) taken as reference product. The results show that Fyfanon 880 EC, at the dose of 1 l/ha, significantly reduced the populations of insect pests and improved the yield of tomato compared to untreated control and Cypercal at 0.6 l / ha.
Keywords: Insect pest, Fyfanon (Malathion), insecticide, tomato, Niger.

Introduction

Tomato, *Solanum esculentum* , is native to Latin America, cultivated for its fruit. It was introduced in Niger by French settlers around 1940 for their exclusive use. It was once practiced only during the dry season along the Niger River by some inhabitants of Niamey, the capital town of the country. The tomato growing procures job to many producers across the country [1]. Tomato contributes to the improvement of food conditions and the increasing of rural and urban incomes. The area devoted to it is not fully known but it was estimated in 2011 at up to 7000 ha with a total production of 109,371 t, representing a yield of 15.62 t / ha [2]. This yield is still very low compared to the potential of the plant. This is partly due to a very important pest pressure, especially that exerted by insect pests [3]. To minimize yield losses, producers use several control measures including chemical control by the use of synthetic insecticides. But the range of existing insecticides registered on the Nigerian market is relatively low and producers often use inadequate insecticides without the desired result. To overcome this deficiency, particular in Niger and in the Sahel in general, the company CHEMINOVA A/S has decided to study the biological effectiveness of Fyfanon 880 EC (Malathion, 880 g / l) in the Niger conditions against the major insects pest of tomato.

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Materials and Methods

Trial implementation

The test was conducted at the Institute of Rural Development College (IPDR) of Kollo on the agricultural experiment site. The previous crop on the plot was tomato, which was grown for several consecutive years. This region is known for endemic attacks of tomato and other Solanaceous crops (pepper, chili, eggplant) by pests and diseases, including whitefly (*Bemesia tabaci*) and locusts in the rainy seasons .

Plant material and experimental Design

The plant material consisted of the tomato variety *Icrixina*, widely grown in Niger.

The trial was conducted in a completely randomized block with 4 replications. Successful treatments were:

T0 = control without insecticide;

T1 = ½ commercial dose Fyfanon 880 EC (0.5 l / ha);

T2 = commercial dose of Fyfanon 880 EC (1 l / ha);

T3 = double dose commercial Fyfanon 880 EC (lha 2)

T4 = Cypercal (Cypermethrin), the reference insecticide at the commercial dose of 0.6 l / ha.

Basic plots were 5 m x 5 m or 25 m^2 in area. The distance between plots was 1 m and that separating the blocks of 2 m. Pepper was transplanted at a density of 0.8 mx 0.40 m.

Soil preparation

As the soil is sandy, plowing was done with hoes and basic fertilizer was applied as recommended by the Agricultural Research standards. It consists of:

- 50 kg of manure per plot (20 t / ha)
- 300 g of mineral fertilizer (NPK as 15-15-15) per plot, what means 120 kg / ha. The nursery was installed under mosquito net to prevent the white fly attacks in the very early stage of the plant. Cover fertilizer consisted of NPK was applied 30 days after transplanting at a dose of 300 g per plot.

As the previous crops are solanaceous for several years a nematicide, Furadan 3G (carbofuran 3%) was applied at a rate of 2 kg ai / ha or 60 kg Furadan / ha to prevent a possible attack of tomato by nematodes. To minimize the effects of bacterial and fungal diseases, two applications of Idefix (copper hydroxide, 65.6 %) were made first 35 days after transplanting and secondly two weeks later.

Insecticide application

Two applications of the insecticides (Fyfanon and the reference product, Cypercal) spaced by 10 days were performed. The slurries were pulverized with a knapsack spryer previously calibrated in accordance with the doses used for each treatment. A volume of well water used to prepare the slurry equal to that used to treat plots with insecticide was sprayed on the absolute control plots; this was done to create the same conditions of wetting in all plots. The application was done in accordance with the conditions laid down by the agricultural extension service that is to say, late in the day and in a relatively calm weather.

Observations

A first observation of insect populations was made one hour before the first application of the insecticides. It was to examine three plants in each elementary plot (on central lines) and to determine the importance of each insect species. Then at 3, 7 and 10 days after each of the two insecticide applications, the importance of each insect population was estimated using abundance scales. For whitefly, it was determined based on the scale of [4], which is composed as follows: low = 0-5 larvae, medium = 6-20 larvae and high > = 20 larvae per leaf. It was made by counting the number of larvae on ten leaves taken at random plots, using a field magnifying glass.

The tomato fruit yield was measured at the end of the third harvest of each elementary plot, leaving the 2 border lines.

Data analysis was performed by ANOVA and mean separation with the LSD test ($\alpha = 5\ \%$) with Minitab.

Results and Discussions

The importance of insect pests observed before the first treatment is reported in Table I. At this point, the whitefly (*Bemesia tabasi*) larvae density averaged 31.5 individuals/leaf. Haougui et al. [5] found a similar density on test plots on tomato cv Roma but in another region. In the region of Diffa (far eastern Niger) *B. tabaci* is one of the major biotic constraints to production of pepper [6]. It is the same in the region of Maradi, in the center of the country where Haougui and Bizo [7] reported its presence in all pepper plots. This shows the real importance of this pest in all regions of Niger and explains why the tomato and pepper crops are repeatedly infected by Tomato Yellow Leaf Curl Virus (TYLCV), for which the fly is a vector.

Table I: Importance of insect pests encountered before the first insecticide application

Insect pests	Part of the plant consumed	Importance
Whyte fly (*Bemesia tabaci*)	leaves	32 larvae/leaf
Grasshopers (*Oedaleus senegalensi, Aiolopus simulatrix, Chrotogonus senegalensis*)	All the aerial parts	0.4 to 1.2 individuals/m^2
Defoliating caterpilar (*Spodoptera exigua*)	leaves	0.3 individuals/plant

Effect of treatments on whitefly populations

Treatment effect, all observation periods combined

The results of the counts of whitefly populations are shown in Table II. The average density ranged from 65 larvae/leaf on the control to 3, 42 larvae/leaf on plants plots that received the double dose of Fyfanon 880 EC. Analysis of variance showed that this dose of the test product significantly (p = 0.000) reduced the populations of the insect compared to the control and other doses of the same product and Cypercal (the reference insecticide) at it commercial dose. The latter product was similar to that of ½ dose effect of Fyfanon 880 EC (0.5 l / ha).

Table II: Average importance of *Bemesia tabaci* (all observation periods included)

Doses	Avarage density (n° larvae/leaf)	Class of severity
Control	64.50 a	3
Fyfanon 880EC, 0,5 l/ha	24.46 b	3
Fyfanon 880EC, 1 l/ha	12.21 c	2
Fyfanon 880EC, 2 l/ha	3.42 d	1
Cyoercal , 0,6 l/ha	19.75 b	2

Numbers followed by the same letter are not significantly different ($p \leq 0.05$)

Evolution of populations of *B. tabaci* after the two insecticide applications

3, 7 and 10 days after the first application, all doses of Fyfanon 880 EC and recommended dose of Cypercal (reference insecticide) significantly reduced whitefly populations compared to the control without insecticide (Table III). The dose of 2 l/ha had a significantly greater effect (p = 0.000) in all treatments, followed by the dose of 1 l / ha and Cypercal at a dose of

0.6 l / ha. This reference insecticide, however, was more effective than ½ dose of Fyfanon 880 EC (0.5 l / ha).

The trend has remained more or less the same after the second application except at 7th and 10th days after, where the effect of the recommended dose (1 l/ha) of Fyfanon 880 EC has impacted significantly (p = 0.000) compared to that of the ½dose of the same product and to that of the commercial dose of Cypercal. This is probably due to the arrival of non-native populations from neighboring plots that have not been treated.

Table III: population trends based on observation periods

Doses	3JAT1	7JAT1	10JAT1	3JAT2	7JAT2	10JAT2
Control	65.25a	57.5a	66.5a	68a	61a	68.75a
Fyfanon 880EC, 0,5 l/ha	28b	25.5b	33.25b	21.75b	17.25b	21b
Fyfanon 880EC, 1 l/ha	11.75d	13c	16d	12.25c	8.75b	11.5b
Fyfanon 880EC, 2 l/ha	4e	3.25d	4.25e	4.25c	1.75c	3c
Cyoercal, 0,6 l/ha	23.25c	20b	25.75c	21.25b	12.25b	16b
CV	8.09	17.21	13.85	22.34	52.46	32.66

Legend: nDATn' = n number of days ; D= day; A= after ; T= treatment ; n'=number of treatments

Numbers followed by the same letter are not significantly different ($p \leq 0.05$)

The average rate of reduction of *B. tabaci* populations during the six observations (3 DAT1 to 10 DAT2) ranged from 94.64% in plots treated with 2 l/ ha of Fyfanon 880 EC to 61.37% on those who received the half dose of the same product (Table IV).

The Cypercal (reference product) has reduced populations of *B. tabaci* by 68.87%. This efficiency has fluctuated slightly during the six observation periods after the two applications of insecticides (Figure 2). The effectiveness of malathion on several insect pests has been reported both in open fields and glasshouses [8, 9, 10]. Studies conducted in Togo showed the effectiveness of Fyfanon 880 EC at the dose of 1.5 l/ha on coffee pests, especially *Helicoverpa armigera* [11].

Table IV: Reduction rate means populations of *Bemesia tabaci* at the last observation (10 days after the second application)

Doses	Average (%)
Fyfanon 880EC, 0,5 l/ha	61,37
Fyfanon 880EC, 1 l/ha	80,93
Fyfanon 880EC, 2 l/ha	94,64
Cyoercal , 0,6 l/ha	68,87

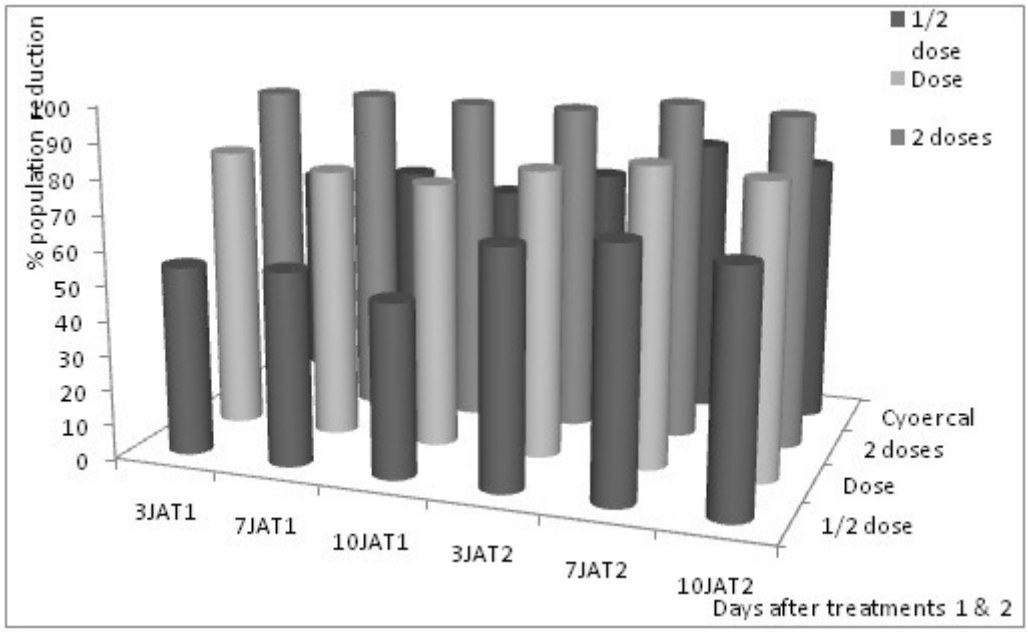

Figure 2: Evolution of the rate of reduction of populations of *B. tabaci* after the first and second Treatments

Observations on other insects

Three and seven days after the first application, grasshoppers and defoliating caterpillar (*Spodoptera exigua*) have completely disappeared from treated plots (any dose range) and they were very low on the control plots (1 < individuals/m2 for grasshoppers < and 0.1 individuals / plant for *S. exigua*). At the end of the observations, e.g. 10th day after the second application, they were no longer seen in the test plots. The insignificance of these insect populations is certainly due to the effectiveness of Malathion against several insect pest species, particularly Lepidoptera as reported by ANSE [8] and ITR [11] on armyworm and *Helicoverpa armigera*. This action was certainly exacerbated by the high rainfall recorded during the growing season because even on the control plots the populations of these insects were negligible.

Other observations

In addition to insects, three diseases were observed on the plots. These are: the bacterial leaf spot disease of tomato caused by *Xanthomonas campestris* pv *vesicatoria*, the Tomato yellow leaf curl disease transmitted by whitefly *B. tabaci*. Throughout the season, they had a low incidence (number of infected plant over the total number of plants). For the bacterial disease incidence was low due to the application of the bactericidal product; this bacterium is especially devastating during the rainy season because of the high relative humidity [12].

Also according to several authors, the spread of the pathogen is particularly favored by splashing droplets of rain accompanied by wind [13, 14].

Tomato yield

The averaged yields of tomato are reported in Table IV. Those obtained on the control plots is consistent with tomato yield during the rainy season reported by Moussa [15] who found 6 to 7 t / ha. Statistical analysis showed that all insecticide treatments significantly improved the yield compared to the control without insecticide. The rate of increase varied from 25.57 % (0.5 l / ha Fyfanon 880 EC) to 48.72 % (2 l / ha of the same product). The reference product (Cypercal) had significantly the same effect as the dose 0.5l/ ha Fyfanon 880 EC of tomato yields.

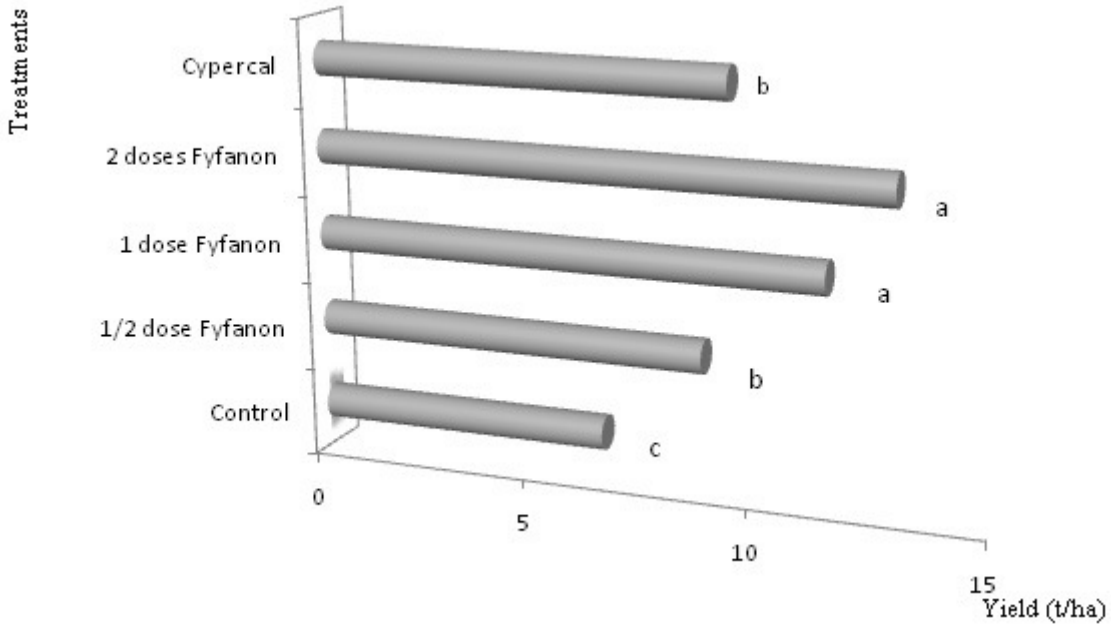

Figure 2: tomato Yields under different doses of Fyfanon and Cypercal (numbers followed by the same letter are not significantly different ($p \leq 0.05$).

Conclusion

The data collected during this trial showed that Fyfanon 880 EC is effective against the most important insect pests (the whitefly, the defoliating caterpillar and grasshoppers). At the recommended dose of 1 l/ha, it has improved the yield of tomato compared to the control without insecticide and the reference product, Cypercal at a dose of 0.6 l / ha.

Aknowledgement

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