

ASSESSMENT OF SIDE-EFFECT OF WATER-SOLUBLE NITROGEN FERTILISERS APPLIED AS FOLIAR SPRAY ON THE PARASITIC WASP *APHIDIUS RHOPALOSIPHI* (DESTEFANI-PEREZ) (HYM: APHIDIIDAE)

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The development and the use of pesticides harmless for natural enemies of agricultural pests is a key factor in the development of Integrated Pesticide Management program and reduction in pesticide use. A great effort to develop selective pesticides has been undertaken since the 70's. However, several other products, as nitrogen fertilisers are also routinely applied on crops in a same way as pesticides and the effects of these products on environment, especially beneficial arthropods, are not known. The aim of this study is to assess the possible side-effects of 3 nitrogen fertilizer formulations applied as foliar spray on the parasitic wasp *Aphidius rhopalosiphi*. This species was selected because it is a key beneficial arthropods for aphid control and a species very sensitive to pesticides, used as "standard species" for ecotoxicological tests in the context of registration at European level. The nitrogen formulation tested were the product Nutriforce® (liquid urea), pearled urea and a nitrogen solution (nitrate, urea and ammoniac in solution). These fertilisers are widely used in crops such as cereal or potatoes. They were tested at their maximum recommended field rate, corresponding to an application of 15-20 N units/ha according to the product.

The nitrogen formulations were first tested on glass plates, according to the IOBC Tier I testing scheme. All formulations exhibit a high toxicity, mainly due to mechanical effects, with re-crystallization of urea and high hygroscopicity of residue. Results clearly showed that Tier I test methodology was not adapted for nitrogen formulations.

Nitrogen formulations were further tested on plants in the laboratory, according to IOBC tier II testing scheme. Fertilizers were applied on barley seedlings infested with cereal aphids. Both mortality and repellence were followed through a 48h period and aphid mummies were left to developed 10-12 days. They were counted by plants and assessed for parasite emergence. Both lethal (mortality) and sub-lethal (aphid mummies production and emergence) were used to calculate reduction in beneficial capacity, compared to a water-treated control. When they were applied on barley seedlings, the three nitrogen formulations were only slightly toxic for adult wasp, with a minimum of 14% corrected mortality with the nitrogen solution and a maximum of 44% with pearled urea. However, a strong reduction in female parasite capacity was observed with 50.4 aphid mummies/female for control and only 13.4, 9.0 and 17.8 aphid mummies/female with pearled urea, nitrogen solution and Nutriforce®, respectively. Emergence rate of the mummies were comparable to control values. Due to effects on reproduction, the reduction of beneficial capacity were comprised between 69.8% and 85.4%. According to IOBC toxicity classes, Nutriforce® was considered as moderately harmful (class 3) and pearled urea and nitrogen solution as harmful (class 4). Magnitude of the effects was similar than for classical insecticides, indicating that foliar nitrogen applica-

tion can have a biological signification for beneficial arthropods and probably also on other organisms exposed to foliar spray.

INTRODUCTION

Development of IPM programs has promoted the use of pesticides selective for beneficial arthropods, as parasites and predators of agricultural pests. However, several other products, as nitrogen fertilizers are also routinely applied on crops in a same way as pesticides and the effects of these products on environment, especially beneficial arthropods, are not known. The aim of this study is to assess the possible side-effects of nitrogen fertilizer formulations applied as foliar spray on the parasitic wasp *Aphidius rhopalosiphi*. This hymenoptera is a key beneficial arthropods for aphid control and a species very sensitive to pesticides, used as "standard species" for ecotoxicological tests in the context of registration at European level.

MATERIAL AND METHODS

The nitrogen formulation tested were Nutriforce® (liquid urea), pearled urea and a nitrogen solution (nitrate, urea and ammoniac in solution). All these formulations are widely used in crops such as cereals or potatoes. They were tested at their recommended field rate, corresponding to 15-20 N units/ha per application, according to the product.

Nitrogen formulations were tested on barley seedlings in the laboratory with two extended lab-test: the first (Extended "A" test) was the same as recommended for pesticides (Mead-Briggs *et al.*, 1997) and the second (Extended "B" test) was an upgrade of the first, where aphids used for assessment of sublethal effects are also exposed to tested product (Jansen, 1998).

RESULTS

Results of Extended A and B test are summarized in table 1 and 2. With the first test, where a sucrose solution is applied before the fertilizers, high mortality were observed with all formulations. The mortalities were mainly due to mechanical effects, parasitic wasp being glued and trapped when fertilizers crystallized. An assessment of sublethal effects was planned, but as most of the surviving females were greatly affected by the products, this assessment was cancelled. With the second test, where sugar solution was replaced by aphid and aphid honeydew, mechanical effects were less and mortality below 50% for the three formulations. However, surviving females were affected and fertility performance were reduced compare to control. The reduction in beneficial capacity reached at least 70% and according to IOBC toxicity classes, these products can be classified as moderately harmful (class 3, Nutriforce®) or harmful (class 4, Pearled urea and Nitrogen solution). Compare to pesticides, the toxicity was similar to those of some pyrethrinoids.

Table 1. Effects of nitrogen fertilizers applied as foliar spray on adults on the parasitic wasp *A. rhopalosiphi*. Results of the extended lab "A" test on plants using a standard test as for registration of pesticides

	% of wasp on plants*	Observed mortality	Correct mortality
Control	31.1 % a	10.0 % a	-
Nitrogen solution	26.4 % a	58.0 % b	53.3 %
Pearled urea	25.7 % a	76.0 % b	73.3 %
Nutriforce®	17.1 % b	61.0 % b	56.7 %

* Results followed by different letters are statistically different (Student t-test, $p=0.05$)

Table 2. Effects of nitrogen fertilizers applied as foliar spray on adults on the parasitic wasp *A. rhopalosiphi*. Results of the extended lab "B" test on plants using a standard test as for registration of pesticides upgraded assessment of sublethal effects

	% wasp on plants*	Observed mortality	Aphid mummies/unit	Aphid mummies hatching rate	Reduction beneficial capacity (E)
Control	34.7 % a	0.0 % a	50.4 a	87.0 % a	-
Nitrogen solution	43.7 % b	14.0 % a	9.0 b	86.5 % a	84.7 %
Pearled urea	33.4 % a	44.0 % b	13.8 b	75.0 % a	86.8 %
Nutriforce®	19.4 % c	16.0 % b	17.8 b	86.9 % a	70.4 %

* Results followed by different letters are statistically different (Student t-test, $p=0.05$)

CONCLUSIONS

Effects of nitrogen fertilizers on the non-target arthropod *A. rhopalosiphi* on plants using two different methods were sufficient to reduce the beneficial capacity of the parasitic wasp up to 85.0%, with observation of lethal and sublethal effects. Effects were comparable to those of several insecticides. Further research are needed to determine possible long-term effects of foliar fertilizers in the field on beneficial arthropods.