English Version

Water supply for sprayers and estimative of the effects over the environmental risks with agrotoxics in small properties

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Abstract

Water has a great importance for the survival of living beings, therefore it is increasingly expressive the search of alternatives which reduce the environmental impact caused by the activities of production, for agriculture, markedly the use of agrochemicals. This work has as objective to develop a study about the cost of implantation and estimative of the effect of the community water supply in the management of agrotoxics based in the soybean, maize, bean and wheat production in small properties in Rio Novo and Santa Luzia, in the municipality of Candói – PR. The methodology of the work was constituted in different steps, including the definition of the place, considering the representative agricultural characteristics for the agricultural model practiced in the small properties in most part of the state of Paraná; definition of model of water supply and prevision of costs, and c) realization of the work of construction of the water supplies in the communities, d) estimative of the effects of the use of water supplies over the reduction of the discharge of residues of the agrochemicals in the places of study. Together with this, it was surveyed the characteristics of the agricultural areas, collecting information about the produced cultures and the phytosanitary treatments applied trough spraying. For the calculation of the risks of contamination in the moment of the supply it was considered characteristic data of the place, besides the information available in the literature. It was verified that the use of community water supply represents an alternative for the management of agricultural sprayer in the stage of preparation of the solution, with potential to reduce the volume of agrotoxics to be released in the environment in the moment of supply of the sprayer. The community water supply presents technical execution of low cost with economical viability for small rural properties.

Keywords: Water quality, environmental pollution, agrochemicals.

Introduction

The attention concerning environmental issues is increasing in the world society. In FAO (2002) it can be observed considerations that the results of the application of agrochemicals over the food production represent undeniable benefit, which guarantees more stability in the availability and some characteristics of quality. However, the management and application of these products in an appropriate form increase the risks of occurrence of possible problems caused by these products, for human and animal health and for the environment. For Fernandes Neto and Scarcinelli (2009) most of the chemical contaminants present in underground and superficial water is related to industrial and agricultural sources.

The industrial pollution presents polluting potential highly superior to the agricultural. However Tomita (2002) describes that although agriculture is only one of the several non point sources of pollution, it is generally pointed as the most contributing of all. The great areas occupied by the agricultural sector and the questions of standardization and monitoring contribute for this characterization. Palma et al. (2004) emphasize the risks of deposition and inappropriate management of agrotoxics in the rural environment in relation to the environmental impacts associated to soil and water, considering that the rivers and superficial water are directly affected by the inappropriate use and management of these products.

The need of improvement in the management of agrotoxics in the agriculture is evident, considering the existing problems. Veiga et al. (2006) in study in region of production of tomato verified that 70% of

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the points of collection of water analyzed present detectable contamination which, according to the authors, confirmed the hypothesis that the agrotoxics when applied in agriculture may contaminate the superficial and underground water systems. Marchezan et al. (2007) demonstrate the presence of agrochemicals derived from rice crops in the water of rivers from the center region of the State of Rio Grande do Sul. Data of superficial water pollution and rivers from the South region of Brazil are also presented by Bortoluzzi et al. (2006).

The amount of agrochemicals which reach the water resources is variable, Huber et al. (2000) describe that this amount depends especially on the crops produced, knowledge of the producer, dosage and chemical characteristics of the product and environmental conditions during the application. Once in the water, depending on the physico-chemical characteristics, the residues can connect to the particulate matter in suspension, sediment in the bottom or be absorbed by organisms, and may thus be detoxicated or accumulated. Besides that, Copatti et al. (2009) emphasize results of researches that indicate that these products may be transported trough the water system by diffusion in the water streams or in the body of the water organisms, or even that they might return to the atmosphere by volatilization, evidencing that there is a continuous interaction of the agrochemicals between sediment and water, influenced by the movement of the water, turbulence and temperature.

One of the most important forms in the process of reduction of the risks with use of agrotoxics is directly related to the general aspects and procedures which involve the activity of spraying. Santos and Maciel (2006) consider that the characteristics of quality in the application of agrotoxics involve both the tractor and the sprayer, which must be in perfect conditions of use, free from defects, clean and with the maintaining timely. The water must be of good quality, the procedure of regulation must be observed, there must be a trained operator, trained and in physical and emotional conditions for the performance of the service, observing the ideal meteorological conditions for the application of the product. Perez et al. (2005) consider that the reduction of human and environmental risks in relation to the agrotoxics is directly related with the knowledge and training of the operators of machines and farmers.

In the process of spraying, the environmental contamination may be caused already in the moment of supply of the sprayers, since it frequently occurs losses of solution by leakages, considering that part of this volume will be deposited in the soil (GIL, 2007). In more extreme cases, it is common that the operator perform the supply of the sprayer equipment directly in the water course, making it possible that residues of the storage tank and suction pipe with imperfections in the check valve are disposed outside, depositing in water and soil variable amounts of chemical pollutants derived from the agrotoxics in use. The question of leakages and need of inspection in spraying equipments is discussed by Ganzelmeier and Wehmann (2002) and Gandolfo and Antuniassi (2003).

The main aspects of the need of appropriate structures for caption and use of water in the rural medium and the importance of adjustments in the process of spraying for the efficient use of water in the agriculture are discussed by Faggion et al. (2009). According to the description of Vasquez (2004), it can be verified that the water catchment and transport are important steps in the process of spraying and are directly related to the characteristics of the potential of pollution of the agrotoxics in the process of spraying and with the final costs of spraying.

This work has as objective to develop a study about costs of implantation and estimative of the effects of community water supply in the management of agrotoxics based on the production of soybean, maize, beans and wheat in small properties in Rio Novo and Santa Luzia, in the municipality of Candói – PR.

Methodology

The work was developed in the communities of Rio Novo and Santa Luzia, both located in the municipality of Candói – PR, 25° 34' 20" S and 52° 03' 21"W, in 2007. The predominant soil of the place is classified as Latossolo Bruno Distroférrico[1]. In the region, agriculture is diversified with predominant production of soybean, maize and beans in the

1 According to the Brazilian soil clasification

cultivations from September to May and of the named winter crops as barley, wheat, oak and others in the months from June to November.

The methodology used had different steps: a) definition of the place, considering the representative agricultural characteristics for the agricultural model practiced in the small properties in most part of the state of Paraná; the interest of the rural producers and general conditions of viability in relation to aspects of accessibility and economical for the project, which had the collaboration of the Municipal Government of Candói and of associations of rural producers, b) definition of model of water supply and prevision of costs and c) performance of the work of construction of the water supply in the communities, d) estimates of the effects of use of the water supply over the reduction of the discharge of residues of agrochemicals in the places of study.

For the definition of the model of water supply it was considered as main characteristics the necessity of low investment in relation to the total cost, the capacity of water storage, the use of materials found easily in the market and facility of handling. Since the local presents topography flat-wavy, it was decided to consider the supply by gravity system, common in the region. Considering this, for the cases in which one desires to create similar supply in place where there is the necessity of hold pressure of water for supply, it must be added the cost concerning the pumping system and the conduction of water.

From data collected in loco, it is expected that the water supply must have capacity for achieve the demand of water for spraying of an approximate total of 180 ha in the community of Santa Luzia and approximately 140 ha in the community of Rio Novo, considering this the total of the sum of the area of the rural property of each one of the communities. With these data, it was defined that the capacity of water storage of each supply would be 10 000 L of water. For this estimate it was considered criteria as area size, crops and average demand of spraying, according to table 2 and 3.

For the construction of the water supplies it was established some criteria, aiming to respect maximum conditions of safety, as place with distance of 100 m of residences or commercial establishments or crowds of people, 100 m of water courses (sources, steams, lakes), as well as technical considerations as water caption not superior to 30% of the total volume of water available in the source, which in this case was small surface reservoirs (dams) and use of gravel (absorbing rock) for the absorption of a possible solution leakage. Concerning the last aspect it is emphasized that there are criteria in the current legislation, which regulate structures for the caption of accidental leakage, however they are inert to the places of storage of the defensives in its commercial formulation and not to the places of preparation or disposal of spraying solution, or standardizing the process of spraying in agricultural aviation, as it can be verified in MAPA (2009).

The construction of the water supplies was performed in the period between June 12 and July 16 2007. Later it was calculated estimates of the effects of the use of the water supplies in relation to the discharge of residues of agrochemicals, being considered the soybean, maize, bean and wheat crops, which prevail in the communities of Rio Novo and Santa Luzia in the last years.

The losses of solution by return of the suction piping is lowered to inferior levels and to the reservoir of the sprayer to replenishment was evaluated in the municipalities of Candói and Guarapuava, in the period from March to May 2007, including different places, besides those considered in this study. The evaluation was performed with a total of 26 sprayers with capacity of charge of 600 liters of solution. It was verified that it occurs an average return of 2.85 liters of solution of the earlier charge, which was held in the system piping and which naturally drifts for the exterior before initiating the replenishment by suction. This fact should not occur, however, the system of non-return valve in general was not efficient to avoid flow at insignificant pressure, as in this case, being still verified that in several situations this non-return valve does not exist or it is seriously damaged.

Results and discussion

The study showed that in ordinary periods of cultivation, the producers use an approximate average total of 20 tanks of 600 1 dia^{-1}. Thus, a reservoir of 10 000 liters, when used in a planned way, is sufficient to supply with safety the need of each one of the studied

community. In these conditions, this reservoir may achieve a total crop area expressively larger than the one considered in this calculation, representing the safety margin for the possible variations in the crop areas (Tables 2 and 3).

It was observed viability for the supply of water by gravity in the places of the study, being this a positive factor, since it eliminates the necessity of availability of electric energy in the place, contributing to reduce the costs of implantation of the system and higher malleability in the definition of the place of installation of the reservoir, dispensing the obligation of electric net in the place. In this case, it was necessary to plan the installation of the system considering the adaptations of the leveling of the piping, in order to enable the supply by gravity of the reservoir, and also de sequence of the water flow by gravity, of the reservoir for the spraying equipment.

The implanted system is of simple construction and the compounds present several options of brands and models which are commonly found in the market, which consist basically of constituents for mortar, concrete and masonry, tubes, connections and one water reservoir. In relation to this last item, it was observed that there are nowadays in the market water reservoirs made of different materials, models and capacities. However, for volumes of approximately 10 thousand liters, the greater availability is of those constituted by fiber of glass fiber. In this case it was necessary the construction of one base of armed concrete aiming at security and durability of the structure. This base was made with the dimensions of 0.20 m of height and 2.40 of diameter. In Figure 1, it is presented a scheme with the dimensions of the implanted system.

This set presents an entrance of water direct with diameter of 75 mm and outlet pipe with 100 mm of diameter, being used a ballcock inside the reservoir for automatic control of the supply by gravity. In the entrance of the reservoir it was installed a screen filter mesh 50 (equivalent to 50 perforations per inch^2), aiming to retain material in suspension in the water in order to avoid problems of blockage and wear of the sprayer compounds.

Close to the output of the main piping it was installed an auxiliary output with diameter of 25 mm, which is made to the supply of coastal pumps which present generally capacity of charge of 20 liters, enabling also the supply of this equipment according to the necessities of the producer and which may also be used for other services that need the water supply with low flow.

With these characteristics of dimensions, the supply of the tank is relatively fast, considering that to fill a sprayer of 600 liters, the needed time is inferior to 10 minutes involving the supply itself with open register and more the operations of maneuver of the set tractor sprayer. This agility in the process of supply represents expressive gain of time to the operator of the joint tractor-sprayer, which may be a stimulus for the use of this system, compensating possible necessities of dislocation of points farther from the crops.

In the access, close to the water supply it was placed a layer of gravel, aiming at ease and praticity for the maneuver of the tractor for the activities of supply. In Figure 2 it is presented a scheme with the distribution of the system compounds.

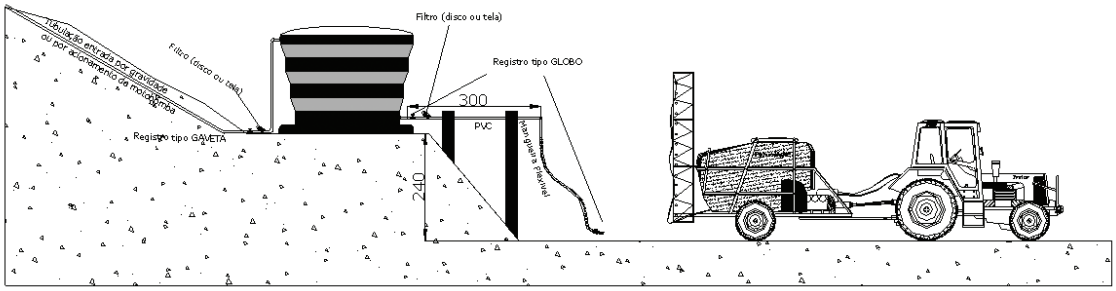

Figure 1. Scheme with details of the compounds, accessories and the installation of the set which makes a sprayer water supply. Candói – PR, 2008.

The estimative of costs for the implantation of the water supply is presented in table 1, considering values for the month of Mat 2007, considering that the total value for the execution of the Project was approximately R$ 3100.00 (OBS: the average value of a soybean bag of 60 kilos in May 2007 in the State of Paraná was R$27.00).

The estimate of the sprayers considering the agricultural activities normally developed in both places of study is presented in Table 2, in which are considered average data of five years before 2007, in relation to the products used and their dosage according to the finality, volume of water used and the number of applications in the cycle of different crops. The most used sequences of cultivation in one year are wheat (July to Nov) with soybean (Nov to Apr) or maize (Sept to Jan) with beans (Jan to Apr). In general, it is not possible the performance of a third cycle of cultivation in the year due to the climate conditions with possibility of frost between April and September.

It is emphasized that the dosage of product used in each spraying, as well as the number of sprays are variables, considering the habits and knowledge of the produces, the occurrence of phytosanitary problems and the efficiency of the product and the technology of application used. Currently, it is observed a trend in the increase of the number of application of fungicides due to the marked increase of the effects of different diseases and pathogens, as instance the Asian soybean rust (*Phakopsora pachyrhizi* Syd. & P. Syd.,), diseases of end of cycle as gray leaf spot (*Cercospora zeae-maydis* Tehon & E.Y. Daniels) in maize, white mold (*Sclerotinia sclerotiorum* (Lib.) de Bary) in bean, among others.

In Table 3 it is presented average data referent to the places of study, considering the cultivated area for each culture and from information found in Table 2, projection of the total of the amount of products (agrotoxics) and water used with estimate of the number of supply of the sprayers, having as reference the average capacity of 600 L.

According to data in the Table 3, it is observed that in Santa Luzia and Rio Novo the average dilution is 3405 liters of product in 791250 liters of water, which represents the presence of 4.3 ml of pure product diluted in each liter of water of the spray solution. Associating this information with the expectation of loss of 2.85 liter per solution per return in the replenishment, it is estimated the release in the environmental of 12.264 ml of pure product in each replenishment. In this line, 1318 replenishments have a potential of release of approximately 16 liters of agrotoxics in its commercial formula for

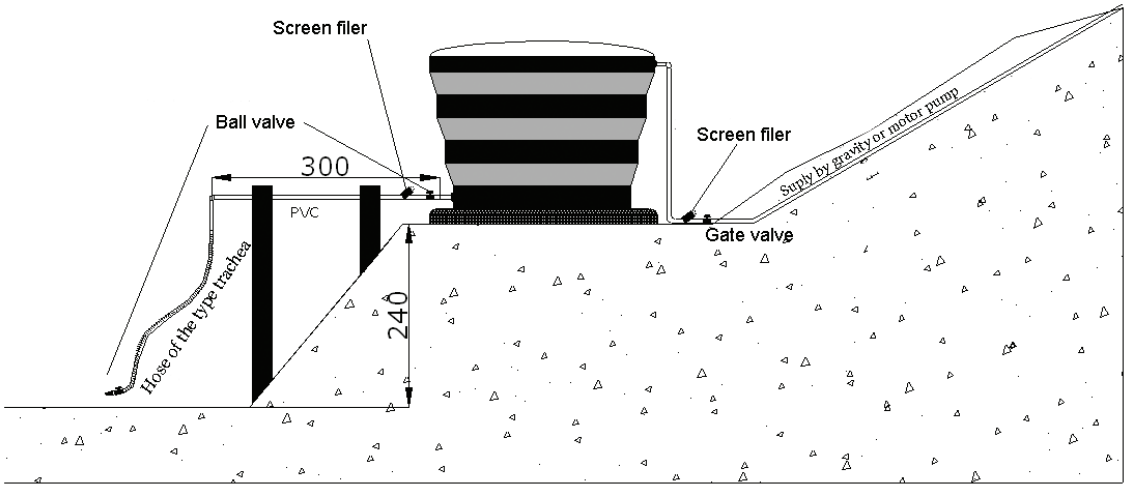

Figure 2. Scheme of the distribution and suggested cotes for compounds, acessories of a set which configures a sprayer water supply. Candói – PR, 2008.

Table 1. Relation of materials, compounds and final cost of the implantation of a water supply for agricultural sprayers, with a water reservoir with capacity of 10 thousand liters.

MATERIAL	QUANTITY	VALUE (R$)
Water tank of fiber 10.000lts	1	1550.00
Black hose of 1"	500 m	0.70
Flange adapter 32X1"	1	11.36
Gate valve of 1.1/2²	1	52.40
Hose of the type trachea 1.1/2"	3 m	6.97
Ballcock 3/4	1	5.55
Pvc pipe 50 mm	3	6.29
Pvc pipe 1"	0.30 m	4.59
Reduction 1"/3/4	1	1.37
Elbow 32 mm	1	2.78
Ball valve 25 mm	1	14.41
Adapter 50X1.1/2"	2	8.00
Adhesive plastic PVC 75 g	1	3.08
Thread seal tape 18x25	1	3.74
Weldable sleeve	4	3.47
Screen filer 50, 75 mm	1	45.00
Cement	2	21.50
Rock	0.5	40.00
Sand	0.5	50.00
Iron 3/8	2	32.00
Brick 6 holes	100	0.22
Gravel	20 TON	15.0
Hour backhoe	2 HOURS	60.00
Workforce*	64 hours	6.25
Total		3104.7

*For equivalence, it was considered commercial dollar as R$ 1.80. *Reference 2 man during 4 days*

the environment, whose elements released to the environment depend on the active principle of each product, and of its concentration.

In the places of study there were no appropriate structures for the supply of the sprayers, it is relevant to consider that the installation of the community water supplies described in this work represents this average potential of reduction of the free release of 16 liters of agrotoxics for the environment. The impacts are expressive, since this discharge, when occurs directly in the water courses, or even in the adjacent soil may cause the direct pollution of a great volume of water, with immediate risks for the aquatic, animal and human lives.

It is observed in Table 3 that these results are originated in a small crop area in aspects of scale of the agricultural production area, however it is still representative of an agricultural model still in practice in great part of the state of Paraná and Brazil. If it is performed projections considering the agricultural area in a broad scale, for instance, as municipality, region, state or country, it will be fatally verified as results alarming numbers concerning direct environmental pollution by agrotoxics and it may also be projected the benefits that structures of supply of sprayers similar to those proposed in this work may cause.

These results may be used to evidence the importance of considering as activity of application of agrotoxics all the process involved with the handling of the chemical products and the equipments of the set tractor sprayer. Not only the step of spraying itself, being the latter the step most considered to refer to the potential risks of the release of agrotoxics in the environment. The fact deserves attention, since the researches and investments tend to promote evolutions concerning the process of technology of application associated with the high priority the step

Table 2. Estimate of the application of agrotoxics and volume of water needed in the crop cycle in an area with one hectare of soybean, maize, bean and wheat, according to characteristics of the communities of Rio Novo and Santa Luzia, in the municipality of Candói – PR.

Activity	Product (Agrotoxics)	Dose ha^{-1}	Volume water (L ha^{-1})	Number of applications
		Crop: Soybean		
Desiccation	Desiccant	2.5	300	1
Plague control	Insecticide	0.2	150	1
Disease control	Fungicide	1.5	250	2
Weed control	Herbicide	1.6	300	1
		Crop: maize		
Desiccation	Desiccant	2.5	300	1
Plague control	Insecticide	0.2	150	2
Weed control	Herbicide	3	300	1
		Crop: Bean		
Desiccation	Desiccant	2.5	300	1
Plague control	Insecticide	0.2	150	1
Disease control	Fungicide	0.8	300	2
Weed control	Herbicide	1	300	1
		Crop: Wheat		
Desiccation	Desiccant	2.5	300	1
Plague control	Insecticide	0.2	200	2
Disease control	Fungicide	0.2	300	2
Weed control	Herbicides	0.1	200	1

Table 3. Annual cultivation and projection of the use of agrotoxics, water and supply of sprayers, considering the characteristics of Santa Luzia and Rio Novo, in the municipality of Candói – PR.

Santa Luzia				
Crop	**Area (ha)**	**Product (L)**	**Water (L)**	**Nº supply (600 L)**
Soybean	90	657	112500	188
Maize	90	531	81000	135
Bean	50	265	67500	112
Wheat	135	459	202500	337
Sub-total 1		1912	463500	772
Rio novo				
Maize	90	531	81000	135
Soybean	75	548	93750	156
Bean	30	159	40500	68
Wheat	75	255	112500	187
Sub-total 2		1493	327750	546
Total		**3405**	**791250**	**1318**

of spraying, according to what can be verified, for instance, in considerations of Chaim (1999), Santos and Maciel (2006).

The present work is directed to the supply of the sprayers, which is a procedure prior to the spraying itself. However, it is relevant that the structures which aim to manage agricultural defensives are appropriate for all the steps concerning the process of spraying, being necessary the complementation with a sector for appropriate disposal of the solution and washing residues of the sprayers. In Brazil, the methodology for structures with this aim is currently being

studied and regulated for the sector of spraying with agricultural airplanes (MAPA, 2009), and may in close future be the base of land spraying.

In relation to the costs of approximately R$ 3100.00 for the implantation of a water supply with the characteristics of this study, it may be emphasized that it is a low financial investment, facing the potential effects which it represents in the reduction of the direct deposition in the soil or water of chemical products derived from spraying solution with agrotoxics. The capacity to achieve until 200 ha when used in a planned way, it represents a positive point, because in the case of small properties several families will be benefited by one structure, in which the existence of difficulties of costing by the producer may justify the investment of different organs, for example the public sector, cooperatives or the companies of the fabrication net and distribution of the products of spraying.

The increasing demand for food and energy causes consequent necessity of evolution and efficiency of the agriculture (CHONCHOL, 2005). The intensification of the agricultural activity is accompanied by the appearance and proliferation of phytosanitary problems which justify the management with agrotoxics aiming at obtaining the quantity and some characteristics of agricultural production (FAO, 2005), however, all this process must occur with proportional attention to the impacts which puts the environmental sustainability in risk (PATERNIANI, 2001). The results observed in this work enabled to verify simple and low cost structures, as the nominated community water supplies, may be important tools, with expressive and immediate results in the way of the referred environmental sustainability, and consequently of the factors associated with it.

Conclusion

The use of community water supply represents an alternative for the management of the agricultural spraying in the step of solution preparation, with potential to reduce the volume of agrotoxics to be released in the environmental in the moment of supply of the sprayer.

The community water supply presents technical execution of low cost with economical viability for small rural properties.

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