ISSN No.: 2455-6130
Special Issue: I, 2022, pp. 150-157

website: www.ijoetr.com

International Journal of Emerging Trends in Research

A NEED FOR PREVENTION OF UNEVEN MIXING OF PESTICIDES, FERTILIZERS AND NUTRIENTS IN SPRAYER PUMP

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Abstract

This paper discusses the spraying of fertilisers using tank mixing method via sprayer pumps and its negative impacts on farmers, soil and the environment. Harmful chemicals are extensively used by farmers in agriculture for better agricultural production which includes insecticides, fertilisers, pesticides, weedicides etc. Tank mix is the most popular method of agricultural spraying by mixing two or more different constituents in one tank. This method enables farmers to supply multiple nutrients and properties of different chemicals at the same time. But with these benefits, there are various disadvantages and harmful effects of tank mix on farmer's health and the environment. Farmers exposure to these harmful chemicals happen mostly during the mixing of different constituents of a tank mix, cleaning of spraying equipment and clogged nozzles. Improper sequence and mixing of constituents in wrong proportions can result in various incompatibilities in the tank and can also cause negative impact on soil and environment.
Keywords: *Agriculture, Spraying techniques, Tank mixing, Physical Incompatibility, Chemical Incompatibility, Environment.*

1. Introduction

Agricultural spraying technique is the treatment and protection of crops by spraying insecticides, pesticides, herbicides, fungicides and other preventive chemicals in the field. Traditionally, spraying of these liquid fertilisers is sprayed via sprayer pump and solid fertilisers via hand spraying operation. Nowadays, many farmers follow a tank mixing method in which two or more liquid and solid chemicals are mixed in one tank. This study discusses spraying of fertilisers using tank mixing methods via sprayer pumps.

There are various advancements in the agricultural sprayers, earlier a single reciprocating pump was used which was operated manually, but now dual pumps are used for better spraying efficiency. It was hand operated which works on mechanical hand operation technique for spraying fertilisers but it requires more effort from the operator. Later this effort was reduced by the introduction of a petrol engine operated pump. Petrol engine was replaced by the diesel engine in a very short span of time but both of these require high operational cost. And then from the past few years there are battery operated pump sprayers which work on electricity by DC charged battery. This is more efficient, gives continuous and low operation cost pumps till date but still has a disadvantage of what if battery gets drained and distance between charging point and field of work is more. Hence, farmers are now preferring 2-in-1 sprayers which can be operated manually and also on battery.

Tank mixing technique is the best technique for application of fertilisers in farm land as it is time, cost and labour saving. It enables farmers to provide multiple nutrients and treatments in a single

application. But with its advantages there are many major drawbacks which have negative impacts on farmer's health and environment. This paper gives an insight into the harsh impacts of in tank mixing technique on farmer's exposure to harmful chemicals, effects of overuse of chemicals on crops, soil and environment when used in inappropriate proportion in agriculture.

2. Literature Review

During analysis on this downside of today's agricultural technique we tend to found numerous literature out of that "Farmers' Exposure to Pesticides: Toxicity varieties and ways that of Prevention" by "Christos A. Damalas and Spyridon D. Koutroubas" recommended that Farmers ar perpetually exposed to high doses of pesticides, that ar typically way beyond that of the shoppers. Farmers' exposure chiefly happens throughout the preparation and application of the chemical spray solutions and through the cleaning-up of spraying instrumentation. The pesticides embrace sure organometallic compounds and lots of older organochlorine compounds that also are cytotoxic and chronic. Later it had been illegal from use in several countries within the Seventies and Eighties. the chance (or hazard) of a cloth is set not solely by its toxicity, however conjointly by the chance of exposure once it's utilized. Factors like the chemical concentration during a formulation, the amount of exposure to the chemical, and therefore the pesticide's route of entry into the build all play a job within the risk of poisoning[1].

"The Cocktail Effect" focuses on "How chemical mixtures is also harming human health and therefore the environment" explains that It offers the impact of the "cocktail effect" of fertilisers within the United Kingdom of Great Britain and Northern Ireland. It reveals that these mixtures seem in our food, water and soil and may have an effect on the health of each humans and life.

Over a 3rd of all the fruit and vegetables tested by the united kingdom government in 2017 and 2018 contained residues of quite one chemical. In 2017, 87.5% of the pears tested contained chemical cocktails, with four-dimensional containing residues of 9 or a lot of completely different chemicals. they need adverse effects on sexual perform and fertility and may negatively have an effect on the system and animal tissue .On the premise of testing disbursed chemical cocktails aren't solely found in fruit and vegetables roughly 1 / 4 of all food things tested. Despite the prevalence of chemical cocktails, there ar proof that they will be a lot of harmful than individual pesticides[5].

"Impact of pesticides use in agriculture: their edges and hazards" by " Md. Wasim AKTAR, Dwaipayan SENGUPTA, Ashim CHOWDHURY" recommended that {insecticides} embrace insecticides, fungicides, herbicides, rodenticides, molluscicides, nematicides, plant growth regulators et al. It offers the event in use of pesticides. edges ar the results of the pesticides' effects – the direct gains expected from their use conjointly rising productivity, several malignancies, high pressure level, cardiopathy, diabetes, stroke, and alternative chronic sicknesses may be prevented by feeding fruits and vegetables on a daily basis. The high risk teams exposed to pesticides embrace production staff, formulators, sprayers, mixers, loaders and agricultural farm staff. as a result of the procedures concerned aren't safe, the chance of risks throughout production and formulation is also increased . Compounds have the potential to poison the tissues of nearly each living creature on the world, in addition because the air, lakes, and seas, in addition because the fish that dwell in them and therefore the birds that eat the fish[2].

a piece of writing was revealed in TOI Nov two, 2017 concerning the fatalities of farmers and agricultural staff as a results of chemical exposure, the establishment has unambiguously declared that no cocktail or tank mixture of pesticides, weedicides, and plant growth regulators is usually recommended. Some farmers used glyphosate (weedicide) simply some days once planting and later for insect blighter management once growing illicit HT RR Flex cotton. Some farmers sprayed the maximum amount as 10 times. Farmers used 2 or a lot of pesticides, plant growth regulators,

fertilisers, fungicides, and alternative chemicals as tank mixtures to save lots of labour, time, and water, the analysis explicit , creating the compatibility of those mixtures and their synergistic or antagonistic effects tough to live.

Insecticide sprays ar worn out the first morning however farm staff sprayed the complete day at several places. Since power sprays ar low volume, to spray over AN acre land the concentration of chemical per tank was increased 3-4 times than used knap sprayers. throughout such spraying a fine mist is generated that stays within the air for a extended time and gets indrawn in larger quantities[6].

Another article was revealed in Elsevier named "Effects of agricultural tank combine adjuvants on the deposition potency of binary compound sprays of foliage", written by P.J. Holloway, M.C. pantryman Ellis, D.A. Webb, N.M. Western, C.R. Tuck, A.L. Hayes, P.C. Miller explained the results of ten commercially obtainable tank combine adjuvants on the retention and coverage of aq. Sprays on foliage were examined quantitatively underneath track sprayer conditions. this text confirmed that tank combine adjuvants will have a substantial influence on the potency of delivery of water sprays. The extent of this impact, on the opposite hand, is set by the additive's composition, formulation, and quantity gift within the spray liquid. This, in turn, has AN influence on the chemistry options of spray droplets, like their size and rate, in addition as their ultimate impaction and spreading behaviour[3].

a piece of writing named chemical Tank Mixes: AN Environmental purpose of read recommended the tank mixture subject is approached from AN environmental purpose of read, explaining the chemical product mixture interactions and therefore the doable material effects. Studies on the product--environment interactions ar conferred to produce the most obtainable data as support to future studies and selections in surroundings, property and safety. whereas the fanner uses 2 with chemicals incompatible substances in tank mixture, high losses in crop yield and instrumentation issues would possibly occur, as an example, sprayer nodule obstruction thanks to reaction between molecules and succeeding compound precipitation [4].

3. Tank Mixing

A. By Adding pesticides and fertiliser before every operation to the sprayer pump:-

Here the pesticides whichever have to be combined and sprayed are to be measured by the measuring cylinders provided on bottle cap and according to the proportions they are added into the spraying tank.

Disadvantages:- Farmers or workers have to measure the proper quantity of liquid by the provided cap i.e, 10 ml,20ml,etc. for each spray interval. It may lead to the high chances of human error during mixing.As these pesticides are very expensive and their inappropriate quantity may cause hazards to the crops.

B. By Mixing in large storage container:-

In this method of tank mixing , the large quantities of pesticides are mixed in the large tank of 1000 L (approx.) and according to the use they are taken and filled in a spray pump for spraying on the crops. It is generally used in case of large scale farming areas.

Disadvantages:-Due to long time interval mixing of pesticides may lead to mutual chemical reactions with each other which may result in the formation of adverse products.

Different incompatibilities also may occur due to the tank mixing for longer duration.

4. Tank Mixing Issues

Along with the advantages, the tank mixing technique has drawbacks too. The tank mixing technique may lead to economic and environmental challenges. During the mixing of products, pH may change, which may lead to undesirable properties. Sometimes during mixing, the products get precipitated and suffer product loss. When the physical incompatibility occurs between the products, it may lead to their separation into different layers. Similarly, if chemical incompatibilities occur in the product may lead to a decrease in the spray quality. Researchers also found the retention of their contents in the grown fruit. Thus they may also lead to severe health hazards. Various significant tank issues are studied which makes this method problematic.

A. Physical Incompatibility

When two physical incompatible products are mixed, it causes a change in colour, odour and morphological changes. Farmer's exposure mainly occurs during the preparation and application of the pesticide spray solutions and during the cleaning-up of spraying equipment.

Reasons for physical incompatibility are:

1. Combining formulations that have not been tested before mixing.
2. Mixing products in the wrong sequence and wrong proportions.
3. Mixing with too much agitation can generate foaming with liquid flowables, whereas mixing with too little agitation can cause dry formulations not to dissolve.
4. When substituting water for fertiliser, compatibility is not taken into account.

The basic manifestations caused due to physical incompatibilities are as follows:-

1)Insolubility: Due to incompatibilities, the product does not get mixed and separated into layers. Some products may settle down at the bottom and lead to cake formation. Also, the products get clogged at different parts of the tank and may block the passage.

2)Immiscibility: Such a product does not mix in a single-phase and leads to remnants of oil residue on the tank wall and also on the rubber hoses. It may be due to incomplete mixing or due to mixing in the wrong sequence or wrong proportions or may be due to temperature.

3) Precipitation:-Incompatibility leads to the formation of a precipitate when the incompatible products are mixed, the liquid solutions may curdle and get thickens into paste or gel, which leads to product losses. Sometimes they may also lead to excess foaming. This incompatibility leads to major product loss and sometimes the tank mixes may lead to the emission of poisonous gas. Hence this incompatibility must be checked before the actual mixing of products.

B. Chemical Incompatibility

Tank mixes may lead to mutual reactions and have an impact on their chemical properties. The chemical changes may occur such as oxidation, hydrolysis, polymerization, isomerization, decarboxylation, combination and formation of insoluble complexes. Also, there may be a change in pH of the products, decomposition or precipitation. The chemical incompatibility that occurs is of mainly two types as:

1) Tolerated: - This type of compatibility is occurring due to the chemical interactions because of the change in the order of mixing the products.

2) Adjusted: - In the case of adjusted incompatibility, a formulation modification with a substance of equivalent therapeutic value is required.

Chemical incompatibility leads to turbidity, precipitation, crystal growth, segregation, discolouration and thickening. It may present antagonism. Chemical incompatibility hampers the spray quality, plant uptake and retention of chemicals on plant surfaces. It may also lead to severe crop injuries a few hours after the application. For example, when the oil adjuvant added to the herbicides increases the cuticle penetration but itimpacts the herbicide that may result in scorching or bleaching on crops.

Fig.1 Chemical Incompatibility

C. Human Impact

Human exposure to pesticides occurs via different pathways such as drinking water, food, residential and occupational. Mainly the farm exposure to pesticides is observed during agricultural practices. It may occur through oral, inhalation or dermal routes. The kind and degree of pesticide related adverse health consequences are dictated by the chemical category, the dose and length of exposure, and the route of exposure.

1) Acute Toxicity: - It refers to the impact of pesticide even after single time exposure to the pesticides. They show symptoms within 48 hours. They may lead to respiratory tract irritation, sore throat and/or cough, allergic sensitisation, eye and skin irritation, nausea, vomiting, diarrhoea, headache, loss of consciousness, extreme weakness, seizures and/or death.

2) Chronic Toxicity: - It is caused by repeated or long term exposure to pesticides. Low exposure does not cause severe illness but long exposure causes very harmful effects on human health. It may lead to the development of asthma, Parkinson's disease, depression and anxiety. In some cases it is linked to cancers including leukaemia.

3) Endocrine Disruptors: - This refers to their impact on hormone and hormone balance. Endocrine exposure is very sensitive and also activated on exposure with less concentration of chemicals. They result in reducing semen quantity by consequently decrease in fertility and genital malfunctions. They also lead to early puberty, diabetes, obesity, hyper and hypothyroidism and thyroid tumours.

4) Carcinogenic Substances:-The substance which leads to cancer is named as carcinogen substance. Single exposure rarely leads to cancer but putative exposure with such substance leads to cancer.

5) Combined effect: The tank mixes have a very adverse impact on human health. The "cocktail effect" leads to the retention of pesticides in vegetables and fruits.

Fig.2&Fig.3 Health Issues

D. Impact on the environment

Modern technology develops different formulations to overcome different diseases occurring in farming. The use of pesticides derives huge revolution in disease control and production quantity. But the excess use of pesticides imposes a negative impact on the environment. They affect different environmental factors such as:

1) Soil: Pesticides enter the soil by direct application or by indirectly as the incorporation of crop residue in the soil. Various processes occur inside the soil such as molecular retention, transport, degradation, and adsorption/desorption. Pesticides interact with soil leads to decreasing soil microbial diversity and also reduction in microbial biomass. Thus they cause disturbances in the soil ecosystem. They also lead to a reduction in organic components of soil. Excess use of pesticides also causes soil erosion.

2) Water: Pesticides leased in the water by lixiviation in which the pesticides move into the soil it further penetrates to ground-level water, by superficial runoff in which the pesticides molecules moves with soil and water runoff or by spraying derivation i.e., the wind carries the molecules during pesticide spraying. They linked with the superficial and underground water contamination. Also, they may incorporate into drinking water and causes health issues too. Pesticides impact the aquatic ecosystem when they are used in larger quantities. Pesticides release chemicals such as copper sulphate which kills fishes and other water animals.

Fig.4 Soil Erosion

5. Objectives

- To design and fabricate an attachable kit for mixing fertilisers and pesticides used in agriculture spraying pumps.
- To restrict inadequate quantities for use of pesticides by the farmer.
- To avoid problems due to mixing of pesticides.
- To prevent chemical reactions between the pesticides as it can lead to adverse impact on crops.
- To allow proper delivery of all contents to every plant.
- To improve spraying methods.
- To increase effectiveness of the pesticides even after spraying them commonly.
- To reduce direct contact of farmers with pesticides which can lead to skin infections like rashes, skin itching , nausea, eye irritation, etc .
- To make sure whether the fertilisers are spraying uniformly or not.

6. Research Methodology

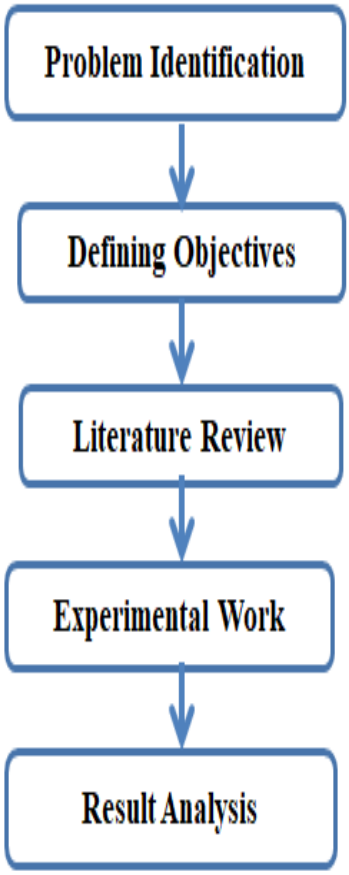

Fig5. Workflow

7. Applications

- The designed kit is attachable to the fertiliser sprayer.
- The fundamental application of this kit is to control the rate and quantity of different fertiliser and pesticides as per the requirement of the crops.
- It enables the spraying of multiple fertilisers and pesticides in required quantities at ease without mixing all components in one tank which can prevent physical and chemical incompatibilities and other harmful effects on crops and farmers.
- The kit maintains the proper proportion of the different chemicals to be applied on crops, preventing human error in measuring chemicals.
- Solves problems which occurs during fertilisers handling

7. Conclusion

Tank mixing is the most prominent method of agricultural spraying with many advantages like reduced labour costs, energy consumption and time. Also minimal machine and human interference in the field allows better crop root development. But based on the study done under this topic it is clear that this method has many harmful disadvantages along with its advantages. It has many harmful effects on the environment, farmer's health and crops. This method increases the exposure of the chemicals to the farmers while making mix and cleaning of the blocked equipment due to several incompatibilities of these chemicals. Hence pesticide mixtures should be compatible with

each component of the tank mixture.It also has negative impacts on soil if not used in appropriate proportion or change in properties that occurs due to chemical reactions taking place in the tank. Hence, a new method should be introduced or this method should be improved in order to solve the drawbacks of the current tank mixing technique so that farmers can use this method more efficiently and with no negative impacts.

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