International Journal of Engineering Science Invention (IJESI)
ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726
www.ijesi.org ||Volume 7 Issue 9 Ver III || Sep 2018 || PP 01-05

A Review On Pesticides Sprayer Technology Approach In Ergonomics, Economics And Ecologic In Agriculture Field.

Mr.Pankaj B. Gavali, Dr. Shashidhar. S. Kalashetty
Assistant Professor, Sanjay Ghodawat Institute, Atigre, Affiliated to Shivaji University, Kolhapur, Maharashtra, India 416118
Professor & Head Industrial & Production Engineering Department, P.D.A. College of Engineering, Kalaburgi, Karnataka, India 585102.
Corresponding Author: Mr.Pankaj B. Gavali

Abstract:*In India many people only depend on agriculture for their livelihood. Earlier former was considered as the backbone of the country. But presently he is struggling very hard to protect his own backbone. Because of erratic climatic conditions, high labour cost and pest and insect attack he is not able improve the crop productivity. Chemical spraying has a very important role to play in minimizing the harvest losses and improving productivity of the crop. Farmers use different types of sprayers for the management of the pest. Successful pest management depends not only on the quality of the pesticide and insecticides, but also on the use of right plant protection appliances. Hence, proper selection based on Ergonomic, Economic, Efficacy and Ecological and use of equipment for pesticide application has direct effect on crop productivity. So in this paper a brief overview is taken based on Ergonomic, Efficacy and Economic with different types of spraying appliances.*

Keywords: -*Sprayers, Pesticide, Ergonomic, Efficacy, vmd/nmd, Volume median diameter,*

Date of Submission: 07-09-2018 Date of acceptance: 24-09-2018

I. Introduction

In recent years of the development of agricultural and environmental conservation programs crop protection product plays an important role for significantly improving crop yields as well as maintaining the Biological efficiency. The sprayers majorly related to deposition of pesticides and drifts of pesticides. Therefore study of ergonomics, economics and ecological of sprayer evaluation serves purpose of enhancing the worker performance, safety, competency and toxicological risks. A deep study is required to understand the different sprayer advancement in view of ergonomics, economics, efficacy and ecologic in sprayers therefore a brief review from different researches is required. The evolution of sprayers for agriculture field will be significant factor for make correct method of using pesticides makes it an important topic for research

In view of the above it is essential to review the sprayers based on the ergonomic, economic, ecological and efficacy of various sprayers in use.

II. Literature Review

The standing and sitting effect of workplace in context with wash area in the household [1]. The main objectives of the study were to design a wash area ergonomically and then test the efficacy. The sample for the study consisted of 30 performers selected on the basis of vision acuity and general wellbeing. The ergonomic design of the wash area was based on functionality, floor size and placement of work centers, ventilation, storage, safety and others. The study reveals that the energy consumption was lesser in the performance of the work in standing position than in sitting in context with the job of washing clothes. Also perceived exertion and spine angle deviation was considerably low when the performers accomplished the job in standing as compared to sitting position.

The chemical risks were present in agriculture, it is therefore necessary to focus on the safety culture that could exist within the profession. This field study took place in the vineyards where the operator is involved in high levels of pesticide exposure. [2] The goal was to identify task factors that contribute to worker exposure during the spraying process. The aim of the study was to identify the mechanisms that encourage or curb the development of a safety culture in viticulture. An activity analysis was performed in 7 vineyards. The data were collected using video recordings. The results suggest that increased physical and temporal constraints lead to an increase in the potential exposure of the operator.

Plant protection products are used in agriculture to improve yields, but this use can cause contamination of the environment and also likely to have adverse short and long term effects on agricultural

workers [3]. And also described a systems approach to reducing the risk of operator exposure to plant protection products through the introduction of ergonomics to the design process of large agricultural sprayers.

Traditional boom sprayers waste herbicide by applying it to areas where weed density is already low. [4] A new technology, Weed Activated Spray Process (WASP), uses sensors to detect the presence of weeds and control spray nozzles accordingly. The economic benefits of this technology to extensive crop farmers in Western Australia were investigated using a model based on the economics of information. Existing technology is likely to reduce profits because the weed density at which it switches off spraying is too high.

The deposition patterns of droplets applied to tomatoes using the commercially available Ulvafan and two prototype hand-held ultra-low volume (ULV) electrostatic sprayers have been compared [5]. A high ratio of droplets on the upper: lower (U: L) leaf surfaces was recorded at most sampling sites after spraying with the Ulvafan. However, a U: L approaching unity was common with the electrostatic sprayers and it rarely exceeded 4:l. Air-assistance was necessary in order to obtain suitable penetration of the foliage using charged droplets. The combination of small droplets (15-20µm vmd) with a narrow droplet spectrum (vmd/nmd 1.06-l.15) with an even U: L coverage shows great promise for the development of machinery providing truly controlled droplet application in glasshouses.

The fruit flies were very important pests on a large number of crops, can be controlled efficiently using low-volume applications to deposit large droplets of insecticidal bait on the exterior of the crop canopy [6]. to meet these requirements a sensor-controlled sprayer was developed, consisting of a hydraulic system that was fitted with air induction nozzles, an ultrasonic sensor and a control unit with display and navigator keys. This sprayer was designed to apply low spray volumes as very coarse spray droplets. The nozzle with the coarsest spray was an AI11003 operated at 0.1 MPa. The sensor recognized differences in crop canopy so could adapt the application to different citrus crop systems in commercial orchards. The sensor-controlled sprayer was tested measuring the size of deposited droplets on the target and observing its performance on the field. This sprayer provides an alternative to cover treatments, not only from environmental but also from economic reasons

Electrostatic force fields have been employed and enhanced in the design of an electrostatic knapsack spray system for increasing the deposition efficiency and reducing the drift of pesticides [7]. The designed induction charge based electrostatic sprayer offers optimum electrode position and electrical conductivity of liquid. The experiments were conducted in ambient conditions for liquid feed rate 340 ml/min at hand pressure of 30 psi. The charge-to-mass ratio was found to be 0.419mC/kg at 3.25 kV by a spray liquid of conductivity 10.25 mS/cm.

Pesticide application at Variable rate holds great potential in precision farming with high efficiency of pesticide use and minimized environmental contamination, [8] while application efficiency depends strongly on the accuracy of the discharge rate on the target area. The study is an initial part of the development of a variable rate sprayer to quantify droplet travel time with four types of nozzle at four different liquid pressures and at four forward speeds using a moisture sensor and laser technology. Performance of droplet deposition at different instants was investigated by moving belt and fluorescent tracer. Sprayer forward speed had a significant influence on droplet transport time, while liquid pressure had less influence

To use minimal pesticide inputs for environmentally safe spray techniques have been developed and apply them only when and where needed with reduced losses to the environment Grzegorz [9]. Two such systems are described: (1) shielded systems that recycle spray liquid that would otherwise be lost; (2) detection systems that recognize where there were gaps in crop rows for which spray was not needed. The results of studies by several research groups prove the relevance of these sprayers in reducing pesticide losses. Shielded spraying allows a reduction in chemical input in orchard protection by up to 85% by exploiting more uniform in-canopy spray distribution, recycling the spray that would otherwise be wasted. Sprayers with target detection systems apply spray only where target trees or bushes are present. This technique can reduce chemical consumption in orchards by 30% and decrease drift by 50%.

Manually operated sprayers a novel venturi-based injection method has enabled a closed pesticide delivery system to be developed [10]. The pesticide concentrate is contained in a bag inside a leak proof bottle which screws into the lance of the sprayer, and therefore does not come into contact with the operator. Water (under pressure regulated by a specialized valve) surrounds the bag, and concentrate is injected into the lance where it was mixed with water pumped from the tank. Consistent dilution rates of between 0.5 and 10% were obtained, at overall flow rates of between 0.5 and 21 min-1.

The three perspectives were reviewed and used to place an economic value on pesticide in agriculture and present associated empirical results [11]. One approach was based on calculations of the marginal productivity; a second strategy considers the expected loss to pests relative to some current or maximum yield; and a third approach, related to the second, calculates the economic effect of banning pesticides, which was effectively the value that producers and consumers place on the chemicals used. Also reviewed the economic effects of government policies to reduce or restrict pesticide use, including regulation and pesticide taxes as well

as use of alternative technologies believed to reduce pesticide use, such as integrated pest management and genetically engineered plants.

The two hand held spinning disc sprayers, one producing electrostatically charged spray, were assessed and compared on Egyptian cotton [12]. The charged droplets produced greater overall deposition with a higher proportion on the undersurface of leaves. Spinning disc sprayers offer smallholder cotton farmers several advantages over higher volume sprays applied by knapsack sprayers.

A simple technique to check the coverage of a certain treatment applied in any crop is Water-sensitive paper [13]. Although it is possible to visually determine if a treatment has been either insufficient or correct, it was advisable to analyse those papers by an image analyser to get reliable results. The study was to demonstrate the accuracy of an automatic system for image analyses to check the coverage percentage of a treatment in a fast and efficient way. For this reason, water-sensitive papers were scanned and split in three levels of grey. After that, a binary image was obtained with only two values: droplet or no droplet. The Image software was then used to analyse this binary image and to establish the categories of coverage. The results obtained proved the accuracy of this software to quickly determine the precision of the treatment applied.

The association between pesticide exposure and neurobehavioral and neurodevelopmental effects is an area of increasing concern [14]. This symposium brought together participants to explore the neurotoxic effects of pesticides across the lifespan. Endpoints examined included neurobehavioral, affective and neurodevelopmental outcomes among occupational (both adolescent and adult workers) and non-occupational populations (children). The symposium discussion highlighted many challenges for researchers concerned with the prevention of neurotoxic illness due to pesticides and generated a number of directions for further research and policy interventions for the protection of human health, highlighting the importance of examining potential long-term effects across the lifespan arising from early adolescent, childhood or prenatal exposure.

Currently few bio pesticides were used commercially as alternatives to chemical pesticides [15]. Part of the problem is that methods of application of biological agents have not been adequately considered. The study reviews current information on the application of biopesticides and concludes that more research and development is needed to develop effective application technologies so that those biopesticides showing promise, under laboratory conditions, can be applied by farmers.

Venturi nozzles were often recommended to reduce drift, which is one of the major pollution sources caused by the application of plant protection products on high growing crops Cruz [16]. The coarse droplets produced by the type of nozzle could however also affect the spray distribution and therefore the efficacy of pesticide treatments, the population of beneficial parasitoids and levels of residues on fruit. For these reasons, the work aimed at providing scientific evidence of any effect in these parameters when using standard (cone) or drift reducing (Venturi) nozzles for citrus foliar applications against California red scale (CRS) applied with conventional axial fan air blast sprayers. Results showed that Venturi nozzles did not affect efficacy in the conditions of the experiment. Moreover, in general terms, no differences were found in the distribution of the spray deposits over the tree canopy, on levels of residues on fruit or on the effects on the population of parasitoids. All these findings suggest that Venturi nozzles can be regarded as a good alternative to the standard cone nozzles for reducing drift of pesticide applications against CRS in citrus under Mediterranean conditions.

Agrochemicals are used to spray on to the crop to protect it from the pests and insects. [17] Pigeon pea growers use different types of sprayers for the management of the pest. Successful pest management depends not only on the quality of the pesticide and insecticides but also the use of right plant protection appliances. Several insecticides newer molecules, botanicals and bioagents are most promising against the pests and insects but efficacy has been limited due to lack of application technology in particular the sprayers employed under field condition.

The ergonomics play a unique role in the protection of people's health and in the preventation of work related health hazards [18]. Ergonomics can do this by integrating concepts from the social science with technological advances to enhance the productive capacity and improve people's health.

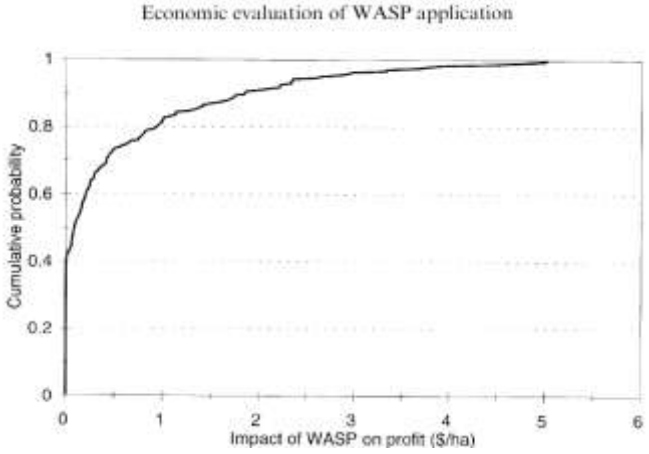
A simple and inexpensive high volume sprayer used for pigeonpea crop [19]. This sprayer remains, in principle, very similar to those designed over 100 years ago, except that most components are now manufactured in polypropylene. In many areas, the recommended spray volume up to 200 l/acre is being used, but the sheer effort of pumping such a large volume of water, even if available, discourages farmers from applying the correct amount of pesticide

An ergonomic evaluation test was conducted to study the postural discomfort of the operator during operation of the LOK sprayer [20]. The data of 18 body dimensions and shape of the back were collected for 10 subjects and their relevance in sprayer design was assessed. The study revealed that though, the workload in the spraying operation was within acceptable limits according to physiological criteria, the maximum discomfort was experienced in the left clavicle region followed by lower back, neck, left thigh and right clavicle. The postural discomfort data indicated a need for better mounting of the sprayer on the operator's back to reduce the postural discomfort.

When pesticide is applied to the crops by a sprayer above the canopy; deposits tend to concentrate on the upper parts of the plants. The conventional response to this problem are the use of higher spray volumes, which are uneconomic al and increase environmental pollution, methods like, the use of air blast to drive droplets into the canopy [21], which is not always effective, and is too expensive, for many farmers in developing countries, to whom ultra-low volume (ULV) equipment has provided the greatest benefit [22].

Early studies which utilized pressure atomizers met with little success [23], since small nozzles were difficult to manufacture accurately, are prone to blockage and produced wide droplet spectra with consequent problem of spray drift. Later, it was realized that the rotary atomizers constituted a potentially more suitable applicator [24]. The flow rate is independent of the applied energy so that relatively large -bore feed tubes may be employed, and atomizer may be designed to produce a spray in which the whole mass is continued effectively within a narrow size spectrum of any desired diameter [25].

In his Studies the author [28] mentioned that traditional sprayer waste herbicides by applying it to area where weed density is already low and investigate the economical benefits of weed activated spray process technique base on model base economics of information and determines the existing sprayers are less effective which simultaneously reduce profit because of weed density at which it switches of spraying is too high. And conclude that WASP improves the profitability of cropping and purchase cost of technology would have to be reduce for resulting positive net benefit. In his paper work he also shown that distribution of gross benefit of WASP if probability of error by set to zero this indicates mean distribution of benefits is increased slightly to a$0.55 per Hectare.



III. Conclusion

In current pesticide spraying technologies for specialty crops frequently result in over-application and excessive off-target losses and spray drift, primarily due to large variations in canopy sizes and densities, plant spacing, and constant pesticide delivery rate offered by conventional sprayers. Existing Works by researcheshas given an idea about on the pesticides sprayers are related to Fluid injection metering, advancement in Nozzle and electrostatic sprayers. The technology which permit sprayers to automatically match spray operating parameters to crop characteristics, insect/disease pressures and microclimatic conditions during pesticide spray applications in field, a technology of an automatic variable-rate nozzle flow control unit comprised of a high-speed laser scanning sensor along with an embedded computer and a touch screen to characterize crop presence, and shape. Therefore the future work can be done on raking of Pesticide Sprayer based on Ergonomic, Economic, and Efficacy and Ecological evaluation.

References

[1]. Vandana Kaushik and Namrata Arora Charpe,"Effect of Body Posture on Stress Experienced by Worker", Stud. Home Comm. Sci., 2(1): 1-5 (2008).
[2]. Mandy Lambert, James Richardson, Sonia Grimbuhler "Ergonomic Analysis Ofpesticide Spraying In Vineyards: Reducing Physical And Temporal Constraints, A Challenge For Reducing Exposure"
[3]. S. Grimbuhler, M. Lambert, J. Nelson, J. Richardson. Pesticide exposure and sprayer design: ergonomics evaluation to reduce pesticide exposure. Work-A Journal of Prevention Assessment & Rehabilitation, 2012, 41, p. 5398 - p. 5399.
[4]. Anne L. Bennett and David J. Pannell, "Economic evaluation of a weed-activated sprayer for herbicide application to patchy weed populations", the Australian Journal of Agricultural and resource Economics, 42:4, pp. 389-408.
[5]. Andrew J. Adams and Anne Palmer, "Deposition patterns of small droplets applied to a tomato crop using the Ulvafan and two prototype electrostatic sprayers",Elsevier, CROP PROTECTION (1986) 5 (5), 358-364.
[6]. P. Chueca, C. Garcera, E. Molto, A. Gutierrez, "Development of a sensor-controlled sprayer for applying low-volume bait treatments", Elsevier, Crop Protection 27 (2008) 1373– 1379.
[7]. Venkata Reddy Mamidi, C. Ghanshyam, P. Manoj Kumar, PawanKapur, "Electrostatic hand pressure knapsack spray system with enhanced performance for small scale farms", Journal of Electrostatics 71 (2013) 785-790.

[8]. Qing Liu,S.E. Cooper, Lijun Qi, Zetian Fu, "Experimental Study of Droplet Transport Time between Nozzles and Target", Biosystems Engineering (2006) 95 (2), 151–157 doi:10.1016/j.biosystemseng.2006.06.013 PM—Power and Machinery.

[9]. GrzegorzDoruchowski, RyszardHolownicki, "Environmentally friendly spray techniques for tree crops", Elsevier, Crop Protection 19 (2000) 617-622.

[10]. Lan P. Craig, Graham A. Matthews and Evan W. Thornhill, "Fluid injection metering system for closed pesticide delivery in manually operated sprayers" , Crop Protection 1993 Volume 12 Number 7.

[11]. Jorge Fernandez-Cornejo, Sharon Jans, and Mark Smith, "Issues in the Economics of Pesticide Use in Agriculture: A Review of the Empirical Evidence", Review of Agricultural Economics--Volume 20, Number 2--Pages 462-488.

[12]. J.F. Cooper, K.A. Jones and G. Moawad, "Low volume spraying on cotton: a comparison between spray distribution using charged and uncharged droplets applied by two spinning disc sprayers", Elsevier, Crop Protection 1998 Volume 17 Number 9.

[13]. JesúsMangado, Silvia Arazuri, Pedro Arnal, Carmen Jarén, AinaraLópez "Measuring the Accuracy of a Pesticide Treatment by an Image Analyzer" Procedia Technology 8 (2013) 498 – 502.

[14]. Leslie London, Cheryl Beseler, "Neurobehavioral and neurodevelopmental effects of pesticide exposures", NeuroToxicology 33 (2012) 887–896.

[15]. Samuel Gan-Mor, Graham A. Matthews, "Recent Developments in Sprayers for Application of Biopesticides: an Overview", Biosystems Engineering (2003) 84 (2), 119–125.

[16]. Cruz Garcer, Carla Roman , Enrique Moltao , Raquel Abad, Jose Antonio Insa ,Xavier Torrent, Santiago Planas c, Patricia Chueca "Comparison between standard and drift reducing nozzles for pesticide application in citrus: Part II. Effects on canopy spray distribution, control efficacy of Aonidiellaaurantii (Maskell), beneficial parasitoids and pesticide residues on fruit", Crop Protection 94 (2017) 83-96.

[17]. Siddegouda, D. B. V. Patil and Yelshetty, S.2007, Performance of different sprayers against gram pod borer, Helicoverpaarmigera(Hubner) on chickpea, Karnataka J. Agric. Sci., 20(2), 261-264.

[18]. TahseenJafryDevid H. O Neill (2000) "The application of Ergonomics in Rural Development: A Review", Applied Ergonomics, 31,pp. 263-268.

[19]. Fischer,H.H., Dutsch A.E. (1985), Lever operated knapsack sprayer, IPCC document 197 No.53-A-84, International Plant Protection Center, Corvallis, Oregon, USA

[20]. B. D. Ghugare , S. H. Adhaoo, L.P. Gite, A. C. Pandya and S. L. Patel "Ergonomic evaluation of lever operated knapsack sprayer", Applied Ergonomic, 22(4), pp. 241-250.

[21]. Holownicki R., Doruchowski G. Godyn A., SwiechowskiW. (2000), Variation of spray deposit and loss with air-jet directions applied in orchards, Journal of Agricultural Engineering Research, 77(2), 129-136

[22]. Stonehouse J.N. (1993), Studies of the distribution of ultra-low volume spray applied within crop canopy, Journal of Agricultural Engineering Research, 54, 201-210

[23]. Courshee R.J.(1960), some aspects of the application of insecticides, Annual Review of Entomology, 5, 327-352

[24]. Linda M.Boize, Dombrowski N. (1976), The atomization characteristics of a spinning disc ultra-low volume applicator, Journal of Agricultural Engineering Research, 21, 87-99

[25]. Walton W.H., Prewett W.C. (1949), The Production of sprays and mists of uniform drop size by means of spinning disc type sprayers, Pro ceedings of Physics Society 62 (6), 342-350

[26]. Klashetty S.S., Dr.Purohit G. K. and Dr.Hebbal S.S. (2011), Analytical Hierarchy process for the selection of the sprayers, International Conference on Advances in Supply Chain and Manufacturing Management (ICASCMM 2011), IIT Kharagpur, 1-11.

[27]. Klashetty S.S., Dr.Purohit G. K. and Dr.Hebbal S.S. (2012), Elicitation and Prioritization of Requirements of Pesticide Sprayers, International Journal of Multidisciplinary Research and Advances in Engineering (IJMRAE), 4 (2), 327-342.

[28]. Anne L. Bennett and David J. Pannell, "Economic evaluation of a weed-activated sprayer for herbicide application to patchy weed populations", the Australian Journal of Agricultural and resource Economics, 42:4, pp. 389-408.

[29]. Pankaj B. Gavali and Prashant H. Patil, "Performance Evaluation of Diesel Engine Using Jatropha & Karanja Oil and Its Blends", Asian Review of Mechanical Engineering ISSN: 2249 - 6289 Vol. 4 No. 2, 2015, pp. 35-41 © The Research Publication, www.trp.org.in

[30]. Mr.Pankaj B. Gavali, Mr. Chandan A.Waghmare &Dr. Shashidhar. S. Kalashetty, "Experimental investigation of changing polarity in powder mixed electric discharge machining (PM-EDM)", International Journal of Engineering and Technology (IJET), DOI: 10.21817/ijet/2016/v8i5/160805423 Vol 8 No 5 Oct-Nov 2016, ISSN (Print) : 2319-8613 ISSN (Online) : 0975-4024.

[31]. Mr. Akshay Patil, Mr. P. B. Gavali, "Experimental Investigation of Material Removal Rate and Surface Roughness in Turning of EN9 Alloy steel using Taguchi Method", Page 1-8 © MAT Journals 2017, Journal of Advancement in Machines Volume 2 Issue 3.

Mr.Pankaj B. Gavali "A Review On Pesticides Sprayer Technology Approach In Ergonomics, Economics And Ecologic In Agriculture Field. "International Journal of Engineering Science Invention (IJESI), vol. 07, no. 09, 2018, pp 01-05