



Projection for Plant Protection Machinery of Kayseri Province

Necati CETİN^{1a*} Bunyamin DEMİR^{2b} Cevdet SAGLAM^{1a}

^a Department of Biosystems Engineering, Faculty of Agriculture, University of Erciyes, 38039, Kayseri-Turkey

^b Department of Mechanical Engineering, Faculty of Engineering, University of Mersin, 33110, Mersin-Turkey

(*): Corresponding author. necaticetin@erciyes.edu.tr; Tel: +90-352-2076666

ABSTRACT (*)

Plant protection covers all the processes regarding the yield loss due to weeds, diseases and pests. Pest control is one of the most preferred plant protection methods which is due to easy to apply and has a high speed of effect. The selection of the spraying unit that carries the pesticide to the target in the pest control plays an important role in the success of the application. However, the adsorption ratio of the pesticide on targets have varies according to the sprayer, the application norm, the interaction between the plant and the environment. In recent years, the production systems in which human and environment have been protected in agriculture, and the safe and controlled use of plant protection machinery has started to gain importance. The aim of this study is to determine the projection coefficients of the machinery technology used in plant protection processes in Kayseri province, Central Anatolia Region and Turkey, depending on between the years of 2009-2018 usage quantities. As a result, the projection coefficients of Kayseri province were determined as 1.46% for atomizer, 3.36% for pto-driven pulverizator, -0.21% for motorized pulverizator, 2.11% for back sprayer, 0.93% for mechanical duster and -3.33% for combined atomizer.

RESEARCH ARTICLE

Received: 10.04.2020

Accepted: 11.05.2020

Available online: 23.05.2020

Keywords :

- Kayseri,
- Pest control,
- Sprayer,
- Projection

(*): The abstract of this study was presented as an oral presentation at the 1st International Erciyes Agriculture, Animal & Food Sciences Conference.

To cite: Cetin N, Demir B, Saglam C (2020). Projection for Plant Protection Machinery of Kayseri Province. Turkish Journal of Agricultural Engineering Research (TURKAGER), 1(1): 104-110.

INTRODUCTION

Plant protection is carried out to reduce weeds, diseases and pests (Rice et al., 2007). Plant protection practices consist of chemical, cultural, biological, mechanical and integrated control. Chemicals are used as the most common pest, disease and weed control method since it is easy to apply them and they are fast-acting (Matthews, 1979; Yağcıoğlu, 1993; Dursun, 2000; Demir, 2015; Çetin et al., 2019).

The success of pesticide applications is directly related to the fact that all parts of the sprayer perform their tasks in harmony (Ozkan et al., 1992). The proper use of the spraying unit makes it possible to carry out the best chemical control (Sayıncı, 2008). Improper spraying reduces efficiency and causes environmental pollution. In the accurate pulverization, the losses in reaching the target are reduced, excessive use of pesticides is prevented, and pulverization efficiency is maximized (Zabkiewicz, 2007).

Proper plant protection agent should initially be selected, it should be applied at the proper time in proper dose with proper spraying machinery. Calibrations should also be done properly to get the best results (Demir, 2015). The aim of this study is to determine the projection coefficients of plant protection machinery technology used in plant protection processes in Kayseri province, Central Anatolia Region and Turkey, depending on the past ten years production and usage quantities.

MATERIAL and METHODS

The material of the study consisted of TUIK plant protection machinery data of Turkey, Central Anatolia Region and Kayseri between 2009 and 2018 years (TUIK, 2019). Considering the ten years of production and usage of plant protection machinery, the percentage ratios of the increase and decrease in their numbers have been calculated and the projection coefficients of these percentage ratios were determined. Depending on the previous year's number of machines belonging to that machine coefficient, Turkey, Central Anatolia Region and Kayseri province used for back sprayer (BS), combined atomizer (CA), pto-driven pulverizator (PTOP), motorized pulverizator (MP), mechanical duster (MD) and the atomizer (A) until 2028 were calculated.

The projection coefficient has been calculated in the following equation (Demir, 2015):

$$\text{Projection Coefficient} = \frac{f2-f1}{f1} \times 100 \quad (1)$$

$$f2 = n\text{year}$$

$$f1 = n - 1\text{year}$$

The positive coefficients of the projection coefficient are the increase in the number of tools and machinery, while the negative result is decreased.

RESULTS and DISCUSSION

In 2018, the most common plant protection machinery is back sprayer followed by pto-driven pulverizator in Turkey. Combined atomizer is the machinery with the least value. As seen in Table 1, according to the projection coefficients, it is predicted that the most common machine which back sprayer would remain the same in 2028. But the least machine is estimated to be as 11139 for mechanical duster in the future.

When the means of projection coefficients were evaluated in Table 2, it is concluded that the maximum increase is in pto-driven pulverizator as 3.44% and motorized pulverizator as 3.07% and the maximum decrease is in mechanical duster as -3.72%. Additionally, as seen in Table 4 and Table 6 pto-driven pulverizator projection coefficients values for Turkey were found to be more than obtained for the Central Anatolia Region values (2.42%) and Kayseri province values (3.36%).

Table 1. Plant protection machinery assets and projections in Turkey

Years	A	PTOP	MP	BS	MD	CA
2009	105036	264421	72494	588556	22996	13955
2010	112738	278761	73745	591373	22800	14188
2011	113641	291505	75905	597460	21543	14020
2012	114435	305295	78151	606366	19509	14303
2013	116789	312651	80457	612626	19307	14325
2014	115995	322174	84093	623190	17827	13811
2015	116883	329768	85974	628059	17855	12731
2016	120402	338625	87486	633598	17749	12802
2017	121448	350272	90832	641819	16762	13832
2018	123790	358407	95143	647442	16268	13997
Years	A	PTOP	MP	BS	MD	CA
2019	126098	370746	98066	654342	15663	14013
2020	128450	383511	101079	661316	15081	14030
2021	130845	396714	104184	668365	14521	14046
2022	133285	410373	107385	675488	13981	14062
2023	135771	424501	110684	682687	13461	14079
2024	138302	439116	114084	689963	12961	14095
2025	140881	454234	117589	697317	12479	14111
2026	143509	469873	121202	704749	12015	14128
2027	146185	486050	124925	712260	11569	14144
2028	148911	502784	128763	719852	11139	14161

A: atomizer, PTO: pto-driven pulverizator, MP: motorized pulverizator, BS: back sprayer, MD: mechanical duster, CA: combined atomizer.

Table 2. Projection coefficients of plant protection machinery of Turkey

Years	A	PTOP	MP	BS	MD	CA
2009-2010	7.33	5.42	1.73	0.48	-0.85	1.67
2010-2011	0.80	4.57	2.93	1.03	-5.51	-1.18
2011-2012	0.70	4.73	2.96	1.49	-9.44	2.02
2012-2013	2.06	2.41	2.95	1.03	-1.04	0.15
2013-2014	-0.68	3.05	4.52	1.72	-7.67	-3.59
2014-2015	0.77	2.36	2.24	0.78	0.16	-7.82
2015-2016	3.01	2.69	1.76	0.88	-0.59	0.56
2016-2017	0.87	3.44	3.82	1.30	-5.56	8.05
2017-2018	1.93	2.32	4.75	0.88	-2.95	1.19
Mean	1.86	3.44	3.07	1.07	-3.72	0.12

A: atomizer, PTO: pto-driven pulverizator, MP: motorized pulverizator, BS: back sprayer, MD: mechanical duster, CA: combined atomizer.

Among the plant protection machinery commonly used in the Central Anatolia Region, the pto-driven pulverizator (114431) takes the first place and followed by the back sprayer (83120) in 2018. It was estimated that pto-driven pulverizator would reach to 145275 and then back sprayer would reach to 97813 in 2028. However, mechanical duster projection coefficient values for Central Anatolia Region would decrease to 292 (Table 3).

Table 3. Plant protection machinery assets and projections in central anatolia region

Years	A	PTOP	MP	BS	MD	CA
2009	3750	92375	9733	71826	566	1285
2010	3777	97367	9736	73590	487	1268
2011	3852	99609	9890	74032	490	1252
2012	3893	102300	10057	76710	483	1256
2013	4265	103501	10328	77379	460	1253
2014	4698	104564	10448	78456	454	1259
2015	4769	106927	10722	80604	463	1278
2016	4851	108642	10962	80825	468	1281
2017	4829	112291	11045	81864	422	1251
2018	4957	114431	11215	83120	411	1234
Years	A	PTOP	MP	BS	MD	CA
2019	5116	117195	11393	84484	397	1229
2020	5281	120025	11575	85871	384	1223
2021	5450	122924	11759	87280	371	1218
2022	5625	125893	11946	88712	359	1212
2023	5806	128934	12136	90168	346	1207
2024	5992	132048	12329	91648	335	1202
2025	6185	135237	12525	93152	324	1196
2026	6383	138504	12724	94680	313	1191
2027	6588	141849	12926	96234	302	1186
2028	6800	145275	13132	97813	292	1180

A: atomizer, PTO: pto-driven pulverizator, MP: motorized pulverizator, BS: back sprayer, MD: mechanical duster, CA: combined atomizer.

Table 4 shows that the highest projection coefficient is obtained in atomizer as 3,21% and the lowest projection coefficient is obtained in mechanical duster as -3,36%. While the highest increase in the number of atomizers occurred in 2013-2014, and the highest decrease in mechanical duster was in 2009-2010. On the other hand, while motorized pulverizator increased by 1.59% in the Central Anatolia Region, it decreased by -0.21% in Kayseri province.

Table 4. Projection coefficients of plant protection machinery of central anatolia region

Years	A	PTOP	MP	BS	MD	CA
2009-2010	0.72	5.40	0.03	2.46	-13.96	-1.32
2010-2011	1.99	2.30	1.58	0.60	0.62	-1.26
2011-2012	1.06	2.70	1.69	3.62	-1.43	0.32
2012-2013	9.56	1.17	2.69	0.87	-4.76	-0.24
2013-2014	10.15	1.03	1.16	1.39	-1.30	0.48
2014-2015	1.51	2.26	2.62	2.74	1.98	1.51
2015-2016	1.72	1.60	2.24	0.27	1.08	0.23
2016-2017	-0.45	3.36	0.76	1.29	-9.83	-2.34
2017-2018	2.65	1.91	1.54	1.53	-2.61	-1.36
Mean	3.21	2.42	1.59	1.64	-3.36	-0.44

A: atomizer, PTO: pto-driven pulverizator, MP: motorized pulverizator, BS: back sprayer, MD: mechanical duster, CA: combined atomizer.

Plant protection machinery assets of Kayseri province are given in Table 5. According to results, it was found that pto-driven pulverizator and back sprayer machinery were the greatest, and mechanical duster and combined atomizer machinery were the least. According to the projection results, pto-driven pulverizator which was in the first place maintained its place and was followed by back sprayer in

2028. It has been observed that there is no change in the number of the least machinery which mechanical duster.

Table 5. Plant protection machinery assets and projections in Kayseri

Years	A	PTOP	MP	BS	MD	CA
2009	149	4048	482	4241	12	73
2010	172	4085	497	4247	13	62
2011	106	4071	428	4224	13	65
2012	115	4118	428	4287	13	60
2013	136	4297	445	4389	13	60
2014	142	4428	456	4456	13	56
2015	142	4455	455	4480	13	56
2016	142	4499	455	4536	13	56
2017	147	4824	461	4717	13	54
2018	149	5416	467	5103	13	53
Years	A	PTOP	MP	BS	MD	CA
2019	151	5598	466	5210	13	51
2020	153	5786	465	5320	13	50
2021	156	5980	464	5432	13	48
2022	158	6181	463	5547	13	46
2023	160	6388	462	5664	14	45
2024	163	6603	461	5783	14	43
2025	165	6824	460	5905	14	42
2026	167	7053	459	6029	14	40
2027	170	7290	458	6156	14	39
2028	172	7535	457	6286	14	38

A: atomizer, PTOp: pto-driven pulverizator, MP: motorized pulverizator, BS: back sprayer, MD: mechanical duster, CA: combined atomizer.

When the changes depending on the years are investigated, it is seen that the greatest decrease occurred in atomizer as -38,37% in the years 2010-2011. The highest mean of the projection coefficient was found to be in the pto-driven pulverizator and the least in the combined atomizer (Table 6). As seen in the projection coefficients, it is predicted that the number of atomizer and pto-driven pulverizator would increase in Kayseri province, Central Anatolia Region and Turkey.

Table 6. Projection coefficients of plant protection machinery of Kayseri

Years	A	PTOP	MP	BS	MD	CA
2009-2010	15.44	0.91	3.11	0.14	8.33	-15.07
2010-2011	-38.37	-0.34	-13.88	-0.54	0.00	4.84
2011-2012	8.49	1.15	0.00	1.49	0.00	-7.69
2012-2013	18.26	4.35	3.97	2.38	0.00	0.00
2013-2014	4.41	3.05	2.47	1.53	0.00	-6.67
2014-2015	0.00	0.61	-0.22	0.54	0.00	0.00
2015-2016	0.00	0.99	0.00	1.25	0.00	0.00
2016-2017	3.52	7.22	1.32	3.99	0.00	-3.57
2017-2018	1.36	12.27	1.30	8.18	0.00	-1.85
Mean	1.46	3.36	-0.21	2.11	0.93	-3.33

A: atomizer, PTOp: pto-driven pulverizator, MP: motorized pulverizator, BS: back sprayer, MD: mechanical duster, CA: combined atomizer.

Kayseri province, Central Anatolia Region and Turkey mean of the projection coefficients were compared in Figure 1. The highest positively change occurred in pto-driven pulverizator. Mechanical duster machine has a negative mean of the projection

coefficient in the Central Anatolia Region and Turkey, while it is positive in Kayseri province.

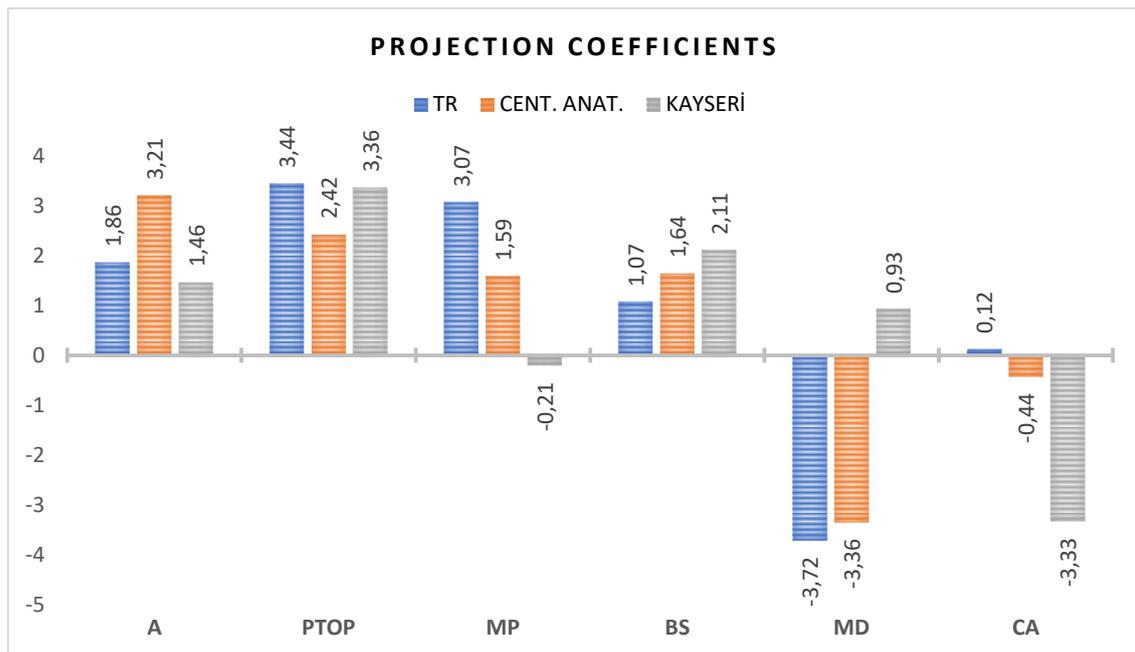


Figure 1. Average of projection coefficients

(A: atomizer, PTO: pto-driven pulverizator, MP: motorized pulverizator, BS: back sprayer, MD: mechanical duster, CA: combined atomizer)

CONCLUSIONS

Turkey, Central Anatolia Region and Kayseri province projection of plant protection machinery, in line with the projection of a positive coefficient of determination would increase until 2028. The projection values obtained from Kayseri province in the atomizer machinery is similar to Turkey, but it is the lower than the Central Anatolia region. The motorized pulverization projection coefficient is also lower than the Central Anatolia Region and Turkey, and it was calculated as negative.

It is predicted that depending on the projection coefficient of mechanical duster machinery would decrease in the next 10-year period in Turkey and Central Anatolia Region and, was increased in Kayseri province. Pest control would be at the top of the preferred agricultural protection applications in terms of its advantages and ease of application. Therefore, in order to eliminate the harmful effects of pesticides and to provide the effect of the agricultural protection, the technical characteristics of the plant protection tools and machinery should be well known, their calibration and maintenance should be done correctly and regularly.

DECLARATION OF COMPETING INTEREST

The authors must declare that they have no conflict of interest.

CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

The authors declared that the following contributions are correct.

Necati Cetin: Writing-original draft, methodology, formal analysis, review and editing

Bunyamin Demir: Writing-original draft, methodology

Cevdet Saglam: Writing-original draft, Formal analysis

REFERENCES

- Çetin N, Sağlam C and Demir B (2019). Determination of Spray Angle and Flow Uniformity of Spray Nozzles with Image Processing Operations. *Journal of Animal and Plant Sciences*, 29 (6): 1603-1615.
- Demir B (2015). A Projection for Plant Protection Machinery of Central Anatolia Region. *Alınteri Zirai Bilimler Dergisi*, 28 (1): 27-32. (In Turkish).
- Dursun E (2000). Meme aşınmasının pülverizasyon karakteristiklerine etkileri. *Ekin Dergisi*, 6 (21): 62-66.
- Matthews GA (1979). Pesticide Application Methods. *Longman*, 1-325 pp.
- Ozkan HE, Reichard DL and Ackerman KD (1992). Effect of orifice wear on spray patterns from fan nozzles. *Transactions of the ASAE*, 35 (4): 1091-1097.
- Rice PJ, Rice PJ, Arthur EL and Barefoot AC (2007). Advances in pesticide environmental fate and exposure assessments. *Journal of Agriculture and Food Chemistry*, 55 (14): 5367-5376.
- Sayıncı B (2008). *Determination of spray application performance into potato canopies with spinning disc and hydraulic spray nozzles, and biological activities with spinosad for Leptinotarsa decemlineata Say (Coleoptera: Chrysomelidae)*. Doctoral thesis. Atatürk University, Graduate School of Natural and Applied Science, p 239, Erzurum-Turkey (In Turkish).
- TÜİK, (2019). Türkiye İstatistik Kurumu. Tarımsal Alet ve Makine İstatistikleri. <http://www.tuik.gov.tr> (02.04.2019) (in Turkish)
- Yağcıoğlu A (1993). Bitki Koruma Makinaları. *Ege Üniversitesi Yayınları, Ziraat Fakültesi Yayın No: 508*, 338 s. Bornova, İzmir (in Turkish).
- Zabkiewicz JA (2007). Spray formulation efficacy- holistic and futuristic perspectives. *Crop Protection*, 26(3): 312-319.