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Pamuk Bitkisi Defoliant Uygulamalarında Bazı Püskürtme Yöntemlerinin Etkinliklerinin Belirlenmesi

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Anahtar Kelimeler:
Pamuk defoliant
Hava emişli meme
İkiz jetli meme yelpaze hüzmeli meme
İlaç birikimi
Kaplama oranı
Yaprak dökme oranı
Kolza açma oranı

ÖZ

Bu çalışma, makineli hasat öncesinde pamuk bitkilerine uygulanan yaprak dökücülerin kaplama oranı ve kalıntı miktarı üzerinde, farklı meme konumlarının etkilerini belirlemek amacıyla tasarlanmıştır. Araştırma, açık alanda saha denemesi ve laboratuvar analizi olarak iki aşamada gerçekleştirilmiştir. Bu çalışmada, iki farklı uygulama hacmi ve üç farklı tip meme ile hasadı yaklaşan pamuk bitkisine standart tarla pülverizetörü ile defoliant uygulanarak sağlanan etkinlik belirlenmiştir. Deneyler, tarla denemeleri ve laboratuvar analizleri olmak üzere iki aşamada gerçekleştirilmiştir. Defoliant uygulama oranları 250 L/ha ve 400 L/ha ve püskürtme memeleri (1) Standart yelpaze hüzmeli meme; (TP8006), (2) Hava emişli meme (AI 11002-VS) ve (3) İkiz jetli meme; (AI307003VP) olarak seçilmiştir. Yaklaşık %60 oranında açık kozalı olgun pamuğa bir izleyici (BSF) ve defoliant uygulanmıştır. Pamuk bitkisi üzerinde biriken defoliantı temsilen BSF birikimi ve pamuk bitkisi üzerine püskürtülen damlaların kaplam oranını belirlemek için bitkinin iki yüksekliğinde (Üst bölge, alt bölge) örneklemeler yapılmıştır. Püskürtmeden önce ve sonra, pamuk bitkilerinde koza açma ve yaprak oranları hesaplanmış ve BSF birikimini tespit etmek için filtre kağıtları ve kullanılan püskürtme yöntemlerinin kaplama oranını ölçmek için suya duyarlı kağıtlar (WSP) kullanılmıştır. Hedefler üzerindeki izleyici birikimi miktarını saptamak için spektroflorofotometre kullanılmış ve WSP'deki kaplama oranını ölçmek için bir görüntü işleme bilgisayar programı kullanılmıştır. Analiz sonuçlarında, 250 L/ha uygulama hacminde hava emişli meme (AI 11002-VS), İkiz jetli meme ve Standart yelpaze hüzmeli memeden daha yüksek birikim, kaplama oranı, yaprak dökümü ve koza açılma oranları sağlamıştır, Ayrıca kullanılan yaprak dökücünün bir göstergesi olarak sadece hava emişli memede yaprak alt yüzeyinde daha fazla BSF birikimi sağlanmıştır. Çalışmada kullanılan defoliant, 250 L/ha uygulama hacminde hava emişli meme ile uygulamadan sonraki 7. ve 12. günlerde koza açma oranı %85 ve yaprak dökme oranı %76 olarak ölçülmüştür.

Performance of Different Spray Nozzles in the Application of Defoliant on Cotton Plants (*Gossypium hirsutum* L.)

Research Article

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ABSTRACT

This study was designed to determine the effects of different nozzle positions on the coverage rate and residue amount of defoliants applied to cotton plants before machine harvesting. The research was carried out in two phases as field trial in open field and laboratory analysis. In this study, the effectiveness of

Keywords:
Cotton defoliant
Air induction nozzle
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defoliant application to cotton plant that has come to harvest with two different application volumes and three different types of nozzles with a standard field crop sprayer was determined. Application rates were 250 and 400 L/ha and spraying nozzles were: (1) standard flat fan nozzle (TP8006), (2) air induction nozzle (AI 11002-VS) and (3) dual pattern nozzle (AI307003VP). A tracer (BSF) and defoliant were applied to mature cotton with approximately 60% open bolls and samplings for BSF deposition and spray coverage on cotton plant were done at two plant height (upper layer, lower layer) of plant. Before and after spraying, bolls open and leaves rate on cotton plants were calculated and filter papers were used to detect BSF deposition and water sensitive papers (WSP) were used to measure coverage rate of spraying methods used. Spectrofluorophotometer was used to detect the amount of tracer deposition on targets and an image process computer program was used to measure coverage rate on WSP. In analysis conclusions showed that air induction nozzle (AI 11002-VS), achieved better results than the dual pattern and standard flat fan nozzles in terms of higher depositions, coverages and leaf defoliations and boll opening rates. AI nozzles operating at 250 L/ha application rate provide the highest deposition and coverage rate on applications of defoliant, in addition, BSF as an indicator of the defoliant used reached on leaf beneath in merely this spray nozzle. After defoliation boll opining rate was 85% on the 7th and 12th days after spraying and falling rate of leaves was 76% at application rate of 250 L/ha with air induction (AI1102) nozzle.

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1. Introduction

Although the most pressing issue confronting the world's rapidly growing population today is definitely the demand for fibers used for various purposes, particularly textiles, the need for fibers used for various purposes, particularly textiles, is not less than the nutritional requirement. Despite continuous increases in synthetic fiber production, cotton (*Gossypium hirsutum* L.) plants are always first among raw materials used in the world textile industry, because it has unique fiber properties that are unmatched for the industry's and its users' expectations and demands, and it has extraordinary structural properties that can never be imitated by human beings. Cotton's quality parameters, which are so vital, should be high, as should yield. Cotton is an industrial commodity that has major contributions to the textile industry with its fiber, to the oil industry with its seed oil, to the livestock sector with its pulp, and to our export and international commerce, despite giving a wide range of business with its agricultural and industry. Cotton fibers are now employed as raw materials in a wide range of industries, including varied textile, fabric, tulle, diverse garments, yarn, twine, bedding, quilting, and smokeless gunpowder. Furthermore, the potential of using the stems that remain in the field after harvest as particleboard, crude fiber, and fuel should be considered (Denizdurduran, 2008). In addition to these factors, the defoliant type, application volume, and spraying technologies employed in defoliate application all have an impact on the rate of defoliation of cotton plant leaves and the pace of boll opening. Many farmers are unaware of the impact of defoliant application equipment on defoliate efficacy. They generally use their existing field crop sprayer on their farm with the same application volume as regular pesticide applications without altering the nozzles or sprayer.

According to the International Cotton Advisory Committee (ICAC) data, 33.7 million hectares of cotton were produced in the world between 2019 and 2020, with India accounting for 37% of this crop. In terms of cultivated land, India was followed by the United States, China, Pakistan, and Brazil. In recent years, the expansion of cotton acreage in African countries has resulted in an increase in the amount of cotton produced and their overall contribution to global cotton output. Despite recent increases in acreage, Turkey is placed 11th, after Mali, Benin, and other African peers. However, this does not appear to have harmed their production ability, since they continue to produce more than most of the aforementioned African countries, as seen in Table 1 (Anonymous, 2019).

Table 1. World cotton cultivation areas (1.000 ha)

No	Countries	2015/16	2016/17	2017/18	2018/19	2019/20
1	India	11.638	10.845	12.235	12.600	12.700
2	America	3.291	3.848	4.492	4.130	4.177
3	China	3.793	3.100	3.350	3.367	3.300
4	Pakistan	2.670	2.496	2.665	2.325	2.631
5	Brazil	1.007	939	1.175	1.618	1.662
6	Uzbekistan	1.272	1.250	1.208	900	900
7	Burkina Faso	631	740	879	646	735
8	Mali	573	656	704	698	782
9	Turkmenistan	534	545	545	534	545
10	Benin	372	418	530	656	700
11	Turkey	440	420	462	520	520
	Other	4.942	4.610	4.950	4.992	5.100
	Total	31.163	29.867	33.195	32.986	33.752

Defoliants are often administered prior to harvest to cause plant leaf loss. These defoliants can be hormonal or herbicidal in nature, but both enhance ethylene production in the plant. Increased ethylene promotes abscission around the leaf stem, causing the leaf to fall off the plant (Yang et al., 2003). Hormonal defoliants cause the plant to produce more ethylene on its own. Herbicidal defoliants, on the other hand, injure the plant, increasing ethylene production in reaction to the injury (Young et al., 2006). The regrowth inhibitor prevents new growth following defoliation and can improve boll quality, whilst the boll opener promotes boll opening and can boost yield. Defoliant applications are normally carried out at predetermined rates determined by the air temperature at the time of application (Edmisten, 2019). Although supplemental chemicals in harvesting have been employed for more than 40 years, achieving the necessary defoliation remains a challenge. Plant, air, chemical, and application elements, as well as their interactions with one another, confound the results and make the reaction to defoliates rather inconsistent. Among the critical decisions that the producer must make are the choice of auxiliary chemicals in the harvest and the timing of application. Plants must be physiologically mature and vegetatively dormant before being used. Early defoliation may result in production loss and lower lint quality in young bolls, late treatments result in early harvest and, as a result, fiber losses. Because early defoliation causes a loss in micronaire and yield quality, defoliation decisions should be made in order to strike a balance between timely harvest and late-season production gains. Before deciding on defoliation, growers will sometimes wait until the bolls on the top of the plant have matured. However, the yield contribution of these bolls is rather minimal (Robertson et al., 2003). Cotton defoliation typically begins in a field when 50-60% of the plants have reached boll opening. Variability in product development, on the other hand, can distinguish this idea. Boll maturation in the near-harvest stage may occur at different times due to the cotton plant's infinite growth (Stewart et al., 2000).

In this study, the defoliant effect (leaf defoliation and boll opening rate), the amount of defoliant deposit on leaves, and the defoliant coverage rate on cotton plants were determined by applying defoliants to cotton plants with two different application volumes and three different spray nozzles.

2. Material and Method

The experiment set was carried out in the experimental field of the Eastern Mediterranean Agricultural Research Institute, which is located around Karataş area, which administratively comes under Çukurova Region. Karataş is located at 36.566429°N and 35.383986°E latitude and longitude. Karataş is in the southern direction of Adana-Turkey (Figure 1).

Figure 1. Map of field trial area

In the experiment within the scope of the research, it was established separately for each application volume, with three replications in accordance with the divided plots the experimentations were designed as randomized block with split-split plot arranged. The trail area consisted of five blocks and 25 plots (Figure 2). In the experiment within each block consisted of five plots and the size of each one was established as 28 m^2 (2.8 m * 10.0 m). Cotton planting was carried out by leaving a gap of 5.0 m between the blocks in the experimental area and 0.7 m between the plots within the block.

Three distinct spraying nozzle methods were used in the scope of the study. All approaches were employed with a conventional field crop sprayer. The sprayer had a tank capacity of 600 L, a 50-bar diaphragm pump, a hydraulic agitation system, an adjustable mechanic boom height attachment mechanism, and a folding boom. The nozzle types and sizes employed in the research were: standard flat fan (size 8006) (Figure 3A), air induction (size 11002) (Figure 3B), and dual pattern (size 307003)

(Figure 3C)- (Spraying System Co., Glendale Heights, USA). Each nozzle was set to two different application rates (250 L/ha and 400 L/ha). Table 2 lists the other sprayer operating parameters. Sprayer speed was modified to achieve the same spraying pressure and application rates for different nozzle sizes.

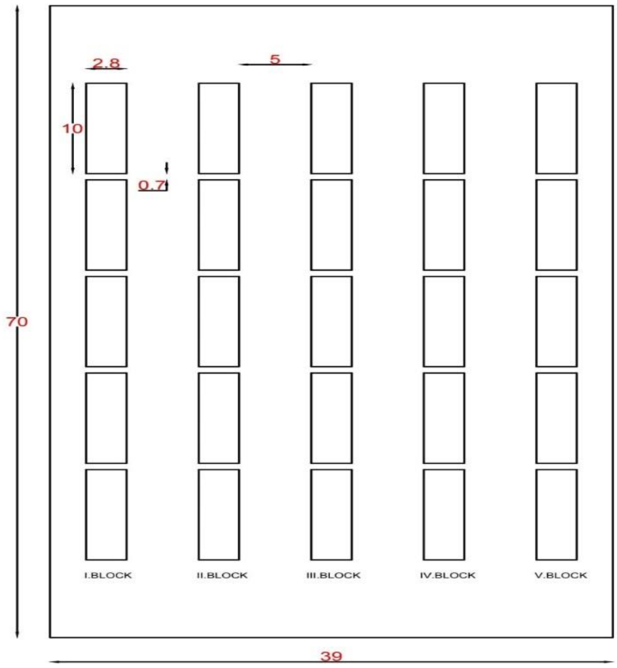

Figure 2. Distribution of experimental plots in the area

Table 2. According to Methods of Field Crop Sprayer Operating Conditions

Spraying method	Operating pressure (bar)	Nozzle flow rate (L/min)	Droplet size class	Forward speed (km/h)	
				250 L/ha	400 L/ha
Standard flat fan nozzle (size TP 8006)	4	2.0	Medium	9.6	6.0
Air induction nozzle (size VS 11002)	4	0.9	Extremely coarse	4.3	2.7
Dual pattern nozzle (size VP 307003)	4	1.3	Coarse	6.2	3.9

Figure. 3. Spray nozzle types used in the research: method 1 (M1) – standard flat fan (A), method 2 (M2) – air induction (B), and method 3 (M3) – dual pattern (C).

A RF-6000 brand spectrofluorophotometer was utilized in laboratory analyses, with values taken at 500 nm wavelength. To calculate the amount of trace particles in the pure water BSF dye solution in the jars, spectrofluorophotometer values were transferred to 4.5 mL spectrofluorophotometer cuvettes.

The droplet analyzer is a device that consists of a scanner, deposit scan software, a computer, and a display to control the analyzed image. The droplets were analyzed using a deposit scan digital scale. Each droplet's attributes include the number of spots, maximum diameter, minimum diameter, equal diameter, area, average diameter of each spot, and so on. The software was used to measure.

In order to evaluate the water sensitive papers used in the studies in the Image Tool program, the appropriate scans were made with a Canon Pixma MP280 brand Printer-Scanner.

The data obtained from the spray nozzles were determined for each application volume determined within the scope of the research. Their nozzles flow rate was measured in three repetitions and the average flow rate was determined for each nozzle. The required tractor speeds were determined for the determined liquid amounts and the targeted application volumes. Equation 1 was used to calculate the tractor spraying speeds for targeted application rates to be achieved within the scope of the trial.

$$N = \frac{600 * Q}{V * B} \qquad (1)$$

Where, N is: - application volume (L/ha), V: - is forward speed (km/h), B: - is the working width of the sprayer boom (m), Q: - is the amount of liquid sprayed from the nozzles (L/min).

In the research, sampling was done on five plants in each plot at two layers of plants (upper and lower layer) on upper and lower surfaces of leaves on the selected each plant. The research was carried out in two stages in each phase of plant development. In the first stage, to detect BSF deposition which was an indicator of defoliant deposition, a solution containing BSF of 0,1-% instead of the real defoliant was sprayed and filter papers were attached to the selected cotton plants to collect the BSF tracer, In the second stage, real application (with defoliant) consisting of Dropp ULTRA plus Finish PRO was applied at the recommended dosages. The volumetric mean diameter of droplets and coverage rate (%) were determined by using water-sensitive papers on the targets just like deposit sampling (Figure 4).

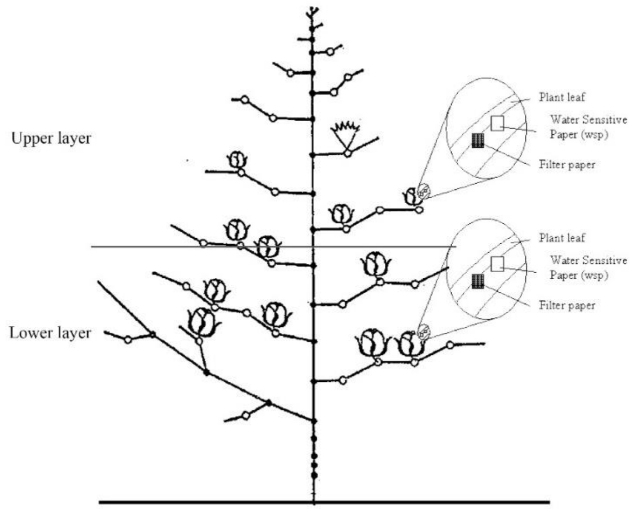

Figure 4. Schematic view of sampling targets on cotton plant

As the plants were not very tall, the sampling was carried out on five plants in each plot and on four leaves of each plant. This meant that randomly selected leaves on the upper and lower surfaces were covered with filter paper and water-sensitive paper. The plants were divided vertically into two zones. In each zone, filter paper and water-sensitive papers were applied to four leaves on both the upper and lower surfaces (Figure 3). The BSF solution was sprayed on each spray method polot after the above test materials had been applied. The WSP papers were cut to a size of 5.0 cm x 2.6 cm and were attached to the sheet with paper clips. The filter papers had a surface area of 10.00 cm^2 and were circular in shape with a diameter of 4.25 cm. As shown in Figure 3, filter papers and water-sensitive papers were placed in 18 packages at the top and bottom of the left, centre and right sides of the plant. Filter papers (Whatman No. 2) were also placed in six interference areas between three plants to measure drift to the ground. The filter papers and water-sensitive papers were collected 15 minutes after spraying was completed. The filter papers were placed in jars and the water-sensitive papers in envelopes, and the samples were taken to the laboratory for analysis of deposition and coverage.

A solution of methyl alcohol (3.33%) and 50 mL of pure water were poured into the filter paper jars and the same were shaken by hand. Samples were then taken from the jar using standard quartz fluorometer tubes and the amount of BSF was measured using the spectrofluorophotometer (an RF-6000). The mean deposits were calculated by dividing the total deposits on the target surfaces by the number of targets for each plant. To determine the coverage rate, the stains on the water-sensitive papers were scanned using a scanner with a resolution of 600 dpi (Canon Pixma MP280). The images obtained were analysed using ImageJ software version 1.38x to calculate the coverage rate. For the purposes of the analyses, water-sensitive papers that changed completely from yellow to blue were considered to be 100%.

To calculate defoliation and boll opening rates, the following method was used prior to treatment application: Five plants were randomly marked to count the number of leaves on each plant. The number of leaves was counted again 1, 4, 7 and 12 days after spraying on the same marked plants.

The rate of defoliation was calculated according to equation (2).

$Defoliation\,rate\ (\%) = ((Na - Nb)/Na)) * 100\%$ (2)

Where, Na is= number of leaves before treatment, Nb is= number of leaves after treatment.

Boll opening rates were determined for each of the five sample plants. The boll opening rate was calculated using equation (3), where the bolls of each plant were examined and recorded as either open or closed. $Boll\ opening\ rate\ (\%) = (Nc/Nd) * 100\%$ (3)

Where, _ Nc = number of opened bolls, Nd = number of total bolls.

To determine cotton yield characteristics and fibre quality, 100 cotton bolls were randomly selected from the canopies (upper and lower layers) and collected in each experimental plot. Cotton yield characteristics such as UHML/mm, UI, Mic, Str, Elg, MR and SFI were considered.

The data were evaluated according to the one-way analysis of variance (ANOVA) in the statistical program and the LSD test was used for the difference between the mean values.

3. Results and Discussions

BSF tracer as Defoliant indicator on targeted was used and among of BSF depositions according to selected application rates and spraying nozzles are given the below with subtitles.

BSF Depositions of Standard Flat Fan Nozzle, Air Induction, and Dual Pattern, Nozzles at an Application Rate of 250 L/ha.

The average amounts of tracer material accumulated on the filter papers in the top and bottom layers of the cotton plant are shown in Table 3. The average BSF deposition, i.e. the average of all selected sampling areas of the cotton plants according to upper and lower layers, was highest for M2 (air induction nozzle, 6,08 μg/cm^2), followed by M1 (standard flat fan nozzle, 5,48 μg/cm^2) and M3 (dual pattern nozzle, 4,67 μg/cm^2).

After M1 and M3, the highest topcoat deposition result is M2, which is the best topcoat performance. In addition, M2 achieved a better result in the lower layers than both M1 and M3 (Table 3).

Table 3. Deposits (μg/cm^2) in Standard flat fan nozzle, Air induction, and Dual pattern, spraying based on a 250 L/ha Deposit application rate.

Methods	Mean Deposit(μg/cm^2)		
	Plant layers		
	Top	Bottom	Average. *
M1	6.43	4.52	5.48 b
M2	7.20	4.95	6.08 a
M3	5.52	3.82	4.67 c
LSD	1.59*		

*: The values shown with the same letters on a vertical column are not significant in the level of $p<0,05$

Findings of BSF in Standard flat fan nozzle, Air induction, and Dual pattern Spraying at an application rate of 400 L/ha

The Table 4 indicates that the deposit rate provided by all of the methods used was highest on the upper and lower surface of the leaf. It was found that the amount of BSF adhering on the plant, particularly in the air induction nozzle method, was significantly (3.48 µg/cm^2) adhered to the upper surface of the leaf. According to the experiment's a significant portion of the spray sprayed with the dual pattern nozzle method was adhered to the upper leaf surfaces (2.97 µg/cm^2), while standard flat fan nozzle methods was adhered to the upper leaf surfaces (2.97 µg/cm^2). As can be seen from these results, while the majority of the deposit measured on the plant using the air induction nozzle method was adhered to the upper surface of the leaf, a better deposit amount of BSF was obtained on the plant using the air induction nozzle method.

Table 4. Deposits (µg/cm^2) in Standard flat fan nozzle, Air induction, and Dual pattern, spraying at a deposit application rate of 400 L/ha.

Methods	Mean Deposit(µg/cm^2)		
	Plant layers		
	Top	Bottom	Average. *
M1	3.63	2.32	2.97 b
M2	4.31	2.65	3.48 a
M3	3.86	2.09	2.97 b
LSD	1.06*		

*: the values shown with the same letters on a vertical column are not significant in the level of $p<0.05$

Coverage Rates in Standard flat fan nozzle, Air induction, and Dual pattern, Spraying at 250 L/ha application rate

Likewise, the Table 5. illustrates that the air induction nozzle method obtained the highest average coverage (26.9%) in 250 L/ha application volume, followed by the standard flat fan nozzle method, which is statistically the same and in the upper group with a value of 18.6%. The dual pattern nozzle method, on the other hand, was statistically included in a subgroup with a 10.4% average coverage rate. When the average coverage rates obtained in 400 L/ha application volume were examined in the same method, the air induction nozzle method obtained the optimal value with 17.1%.

Table 5. Coverage rate values (%) at 250 L/ha Standard flat fan, Air induction, and Dual pattern nozzle

Methods	Coverage rate (%)		
	Plant layers		
	Top	Bottom	Average. *
M1	25.70	11.51	18.6 b
M2	38.99	14.84	26.9 a
M3	16.65	4.22	10.4 c
LSD	2.90*		

*: the values shown with the same letters on a vertical column are not significant in the level of $p<0.05$

Coverage Rates in Standard flat fan, Air induction, and Dual pattern nozzle, Spraying at 400 L/ha application rate

When Table 6 is examined, the standard flat fan nozzle method obtained the highest average coverage rate of 19.7%, followed by the air induction nozzle method, which statistically belongs to the same group with a value of 17,1%. The dual pattern nozzle method, on the other hand, was statistically included in a subgroup with an average coverage rate of 7.5%. It is seen that this value is low in the dual pattern nozzle method both of the upper and lower leaf of the plants.

When the standard flat fan nozzle both upper and lower leaf coverage rate values are considered, it is observed that the highest value is 19.7%. The lowest value in dual pattern nozzle both upper and lower leaf coverage rate is 7.5%. The optimal coverage rate in air induction nozzle is 17,1%. When all coverage rates in a standard flat fan nozzle are considered, it is clear that upper and lower leaf coverage rates are superior.

Table 6. Coverage rate values (%) at 400 L/ha Standard flat fan, Air induction, and Dual pattern nozzle

Methods	Coverage rate (%)		
	Plant layers		
	Top	Bottom	Average. *
M1	21.20	18.13	19.7 a
M2	25.96	8.31	17.1 b
M3	8.50	6.48	7.5 c
LSD	4.94*		

*: the values shown with the same letters on a vertical column are not significant in the level of $p<0.05$

The efficacy of the defoliant, the total amount of defoliant applied and the different spraying methods had a significant effect on the defoliation efficacy. The analysis of variance between defoliation efficacy and the different defoliant spraying methods in relation to cotton parameters is shown in Table 7. The leaf abscission started four days after the spraying and the application rate had a significant influence on the defoliation efficacy; the defoliation rate of the leaves in the upper layer was more than 76% in all three spraying methods. The defoliation rate then gradually increased, and after seven and twelve days of spraying, the defoliation rate of the upper layer of leaves was more than 76% for the three different spray nozzles. The defoliation rate was 76% at the application rate of 250 L/ha with the air induction nozzle method, which was significantly higher than the two low spray methods. The defoliation rates were 72%, 76% and 70% for 250 and 400 L/ha, respectively.

Table 7. Defoliation Efficacy

Methods	Days of counting	Leaf (count)		% Defoliation rate
		Before treatment	After treatment	
M1	1.4	185	50	72
M2	7	187	45	76
M3	12	160	48	70

Boll Opening

As shown in Table 8, there was a significant increase in the opening effect of the cotton bolls after spraying with the different spray nozzles. The rate of boll opening was slightly higher with the high rate of application, but there was no significant difference. However, the cotton leaves wilted without falling and the impurity content in the cotton improved with the highest spray rate with the air induction nozzle method.

Table 8. Effect of defoliant application rate on boll opening by different spray nozzles

Methods	Days of counting	Number of bolls opening (Number)	Number of total bolls (Number)	Boll Opening rate (%)
M1	1.4	50	60	83
M2	7	72	84	85
M3	12	70	85	82

Yield Characters and Fiber Quality

The timing of defoliant application has a major impact on cotton yield and quality. However, there have been few studies on the effects of defoliant application rates and spraying methods on cotton yield and quality. The study shows that the application rate of defoliants and the different spraying methods did not have a significant effect on the yield and fibre quality of seed cotton (Table 9). All treatments had similar results for each of these parameters when three different application methods were used.

Table 9. Effect of defoliant different spraying methods on yield characters and fiber quality of cotton sprayed by PTO field crop sprayer

Treatment	UHML/mm	UI/%	Mic	Str/g·tex	Elg/%	MR	SF (%)
M1	27.36 bc	83.8 b	4.72 a	28.4 b	5.9 a	0.87 a	7.9 a
M2	28.70 a	86.7 a	4.75 a	29.2 b	5.9 a	0.87 a	7.2 b
M3	28.44 b	84.8 b	4.76 a	31.3 a	5.0 a	0.88 a	7.6 b

a–c ($p < 0,05$; Duncan’s Test); UHML, Upper half mean length; UI, Uniformity index; Mic, Micronaire; Str, Strength; Elg, Elongation; MR, Maturity; SFI, Short fiber index.

4. Conclusion

The aim of the present study was to investigate the relationships between three different types of nozzles and the spray quality and efficacy of defoliant spraying in cotton using a power take-off (PTO) tractor mounted sprayer.

There are many factors that have an influence on the success of the spray operation. The main criteria used to express the success of the sprayer include the amount of target crop deposited, the area coverage, the uniformity of the target crop deposited, the number of drops per unit area and the drop diameter. The researchers use one or more of these criteria in their studies in order to decide on the quality of the spraying operation.

According to the research results of this study, the highest performance of the nozzles in the standard flat fan and air induction nozzle increased the amount deposited on the crop and increased the upper leaf coverage values. It was found that the increase in spray rate in the dual pattern nozzle method had little effect on the leaf coverage rate and had the effect of reducing the amount of deposition.

The deposition and coverage rate of BSF increased with the spray volume at an application rate of 250 litres per hectare. The deposition and coverage of BSF increased when the spray volume was less than 400 L/ha. Based on the results of the trial, a spray rate of 250 L/ha, combined with cotton defoliation, boll opening, fibre quality and BSF deposition and leaf coverage, is recommended to be used by growers when applying defoliants using air induction nozzles. The results of the study could be used as a basis for further optimisation of the spraying parameters of cotton defoliants.

In this study, it was observed that air induction nozzle provided good underleaf coverage at both high and low chemical application rates (250 L/ha, 400 L/ha), while dual pattern nozzle systems provided poorer underleaf coverage at both low and high chemical application rates (250 L/ha, 400 L/ha).

From the results of this experimental study, it was found that the air induction nozzle followed by the standard flat nozzle gave the best deposition and coverage rate value at both low and high chemical application rates. The best values for the coverage rate in the under leaf spraying were also obtained with the air induction nozzle. It is concluded that this nozzle position is essential for defoliant spraying, as the penetration of the defoliant to the underside of the plant leaves increases the efficacy of the chemical.

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