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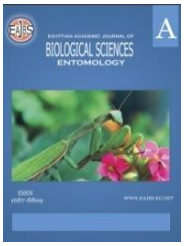

# Study the Biological Efficacy of Chromen Derivatives Formulated as Dustable Powders Against Pink Bollworm, *pectinophora gossypiella* (Saunders) (Lepidoptera: Gelechiidae), Spiny Bollworm, *Earias insulana* (Boisduval) (Lepidoptera: Nolidae), Evaluation of Their Effect on Cotton Yield and Fiber Properties under Field Conditions

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## ABSTRACT

Synthesized formulated chromen derivatives as dustable powders were previously tested biologically against cotton leafworm *S. littoralis* larvae 2nd and 4th instar larvae in the lab and were found to have good insecticidal efficacy. The primary goal of this study was to assess the insecticidal effectiveness of two previously reported synthesized and formulated chromen derivatives as dustable powder formulations (DP) F2 9.5 % and F3 10 % against the pink and spiny bollworms (*Pectinophora gossypiella* and *Earias insulana*), respectively, under field conditions in two different locations, the Agricultural Research Center Station "Quaha" in the Qualyoubia Governorate and "El Mahala El ElKoubra" in "Gharbia" Governorate during 2020/2021 and 2021/2022 seasons. During the seasons of treatment, two distinct treatments, one spray and two sprays were used, and cotton yield and fiber characteristics were also researched. Dustable powder formulation F2 demonstrated stronger biological efficacy on both pests under study than dustable powder formulation F3 for both treatment modalities. During the two study seasons, one spray treatment with dustable powder formulations had a stronger impact on *P. gossypiella* and *E. insulana* than the two spray treatments. In addition, F2 was more effective on *P. gossypiella* than on *E. insulana* in both study governorates and both seasons. Although the yield produced utilizing the F3 dustable powder formulation was far higher than that obtained using the F2, the cotton yield and fiber characteristics were also much better than the control. After all necessary research is completed, dustable powder formulations based on chromen compounds might be applied to control *P. gossypiella* and *E. insulana* in the future.

## INTRODUCTION

In Egypt, cotton (*G. brbadence* L.) is regarded as one of the most significant

agricultural crops for production. The Egyptian ruler encouraged the crop at the start of the 18th century to boost the country's revenue; as a result, the quality of the cotton became legendary and a trademark on the international market, earning Egypt a reputation around the world. Egyptian cotton is more than just a crop; it represents the past and the future of the modern Egyptian renaissance (Karvy, 2009). The Egyptians refer to it as "white gold" (Ahmed and Delin, 2019). The efforts put forth by all related sectors, including research, agriculture, production, marketing, and industry, resulted in a strong competitor that surpasses the quality of global varieties due to its physical, technological, and superior spinning consistency compared to previous varieties that are identical in terms of length grade. This persisted until the middle of the 1980s (Ahmed, 2016). While cotton was a significant export for the Egyptian economy; it was also one of the major sources of revenue for farmers. The primary cash crop and agricultural export commodity for Egyptian farmers has always been cotton (Soliman & Ewaida, 2005). One million people are employed directly and indirectly by it, and it spends 26 billion Egyptian pounds in agriculture and related sectors including the textile, dyeing, and apparel industries. This crop is crucial for ensuring food security; cotton seeds are also used as oil seeds and in the feed sector. Additionally, nearly 40% of its output was exported (Ahmed and Delin, 2019).

The pink bollworm (*Pectinophora gossypiella*), the spiny bollworm (*Earias insulana*), and the cotton bollworm (*Helicover paarmigera*), which caused significant harm to both quantity and quality, are among the insect pests that limit cotton yield globally (Vonzun *et al.,* 2019).A destructive lepidopteran pest of cotton and one of the most invasive insects in the world, the pink bollworm (Pectinophora gossypiella), was discovered in the United States for the first time in 1917 (Tabashnik *et al.,* 2021). Over the past 50 years, it is projected that invasive species have cost the global economy $1.288 trillion (Zenni *et al.,* 2021). In 32 million hectares, cotton is the most significant commercial crop grown in over 100 nations. When left uncontrolled, the larvae of the bollworm complex attack squares and bolls, resulting in severe yield losses (Ali and Khan, 2007). The pink bollworm, one of the bollworms, recently gained a reputation as a serious pest and is known to reduce seed cotton output as well as oil content, normal boll opening, and locule damage. Pink bollworm, the most economically damaging pest of cotton in the world, is known to reduce cotton seed yield by 2.8 to 61.9 percent, oil content by 2.1 to 47.1 percent, and boll opening by 10.7 to 59.2 percent (Anjum, 2019).

*Earias insulana*, a bollworm, is a serious pest of cotton (Zakaria, 2021). One of the most devastating insect pests, the spiny bollworm (SBW), *Earias insulana* (Boisduval) (Nolidae: Lepidoptera), has been identified as the cause of significant economic losses in the cotton crop in Egypt (Nada *et al.,* 2010). The primary cotton pest, the spiny bollworm, damages cotton squares, flower buds, flowers, seeds, and fiber, especially during the late stages of cotton plant growth, which results in a reduction in the quantity and quality of lint and oil of the harvested crop Salem, (2008).

According to reports, cotton's two main bollworm species-pink bollworm *Pectinophora gossypiella* (Saund.) and spiny bollworm *Earias insulana* (Boisd.) cause 30-40 % yield losses, raise insect control costs and result in significant indirect losses due to the eradication of beneficial insects and the emergence of insecticide resistance in cotton (Haque, 1991; Mireulle *et al.,* 1999 and El-Bassiony, 2001).

Around the world, cotton uses up to 60% of all commercially available pesticides (Yadav *et al.,* 2019). Insecticides are a major component of traditional insect pest management methods. The difficulty of managing pests has increased during the past two decades as more insect species become resistant to insecticides (Kranthi, 2007).The extensive use of broad-spectrum pesticides like organophosphorus (OP) on cotton led to the emergence of insecticide-resistant pest populations and a marked decline in the numbers of

parasitoids and predators of the primary cotton pests (Hillocks, 1995). Insecticide resistance, which was brought on by the overuse of insecticides on the crop, has a specific impact on cotton pest management. Resistance to pesticides made them ineffectual, increasing the need for more applications, resource waste, and subsequent ecological pollution (Kranthi, 2007). In Egypt also, tolerant and resistant strains of cotton pests have emerged as a result of the continued widespread use of prescribed synthetic insecticides (Seleman, 2014)

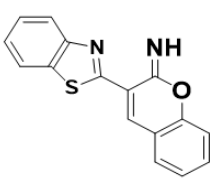
The cotton leafworm *Spodoptera littoralis* (Lepidoptera: Noctuidae) larval 2nd and 4th instar stages were successfully inhibited by chromen dustable powder formulations under laboratory conditions, and both stages were prevented from completing their lifecycles. The 4th instar larvae's histopathological examination revealed that these dustable powder formulations resulted in weak epicuticle necrosis, separation of epidermal cells from the cuticular layer, necrosis, ruptured columnar cells with pyknotic nuclei, damage to the basement membrane, and ruptured columnar cells with pyknotic nuclei. a disrupted columnar structure, muscle cell necrosis, vacuoles, and a destroyed peritrophic matrix in the midgut (Hamouda *et al.,* 2022).

The objective of the current study was to assess the biological effects of two recently published dustable powder formulations on the pink bollworm (*Pectinophora gossypiella*) and the bollworm *Earias insulana* under field conditions, as well as their impact on cotton production and characteristics. Ali *et al.* (2010) showed that significant differences were observed among the tested cotton varieties (CIM-473 and CIM-482) in upper half mean length, micronaire value, and fiber bundle strength. Tolba (2017) reported that mean values of upper half mean length, fiber uniformity ratio, short fiber content, micronaire value, fiber maturity %, fiber bundle strength, and fiber elongation are affected by cultivar. Yang *et al.* (2021) showed that all fiber technology was significantly affected by cotton varieties NT, L 16 and L 36. L 16 variety exceeded the other varieties in mean values of upper half mean length, fiber uniformity index, micronaire value and fiber bundle strength and elongation percentage

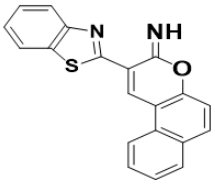
## MATERIALS AND METHODS

### 2.1. Synthesis and Formulation of Tested Chromens:

3-(benzo[d]thiazol-2-yl)-2H-chromen-2-imine (2a) and 2-(benzo[d]thiazol-2-yl)-3H-benzo[f]chromen-3-imine (2b) compounds were synthesized according to (Hamouda *et al.*, 2022) and formulated as dustable powder formulations F2 and F3 respectively according to the standard method (Furmidge, 1972).




**2a (F2)**




**2b (F3)**

**Fig. 1**: Chemical structure of the synthesized chromen derivatives 2a and 2b formulated as dustable powders (F2) and (F3) respectively.

### 2. Bioassay

**Field Experiment**:

To compare the effects of the two dustable powder formulations (F2) and (F3) on both pests under study Pectinophora *gossypiella* (Saund.) and *Earias insulana* and on the yield product, a field experiment was carried out at two separate locations: the Agricultural

Research Station "Quaha" in "Qualyoubia" Governorate and "El Mahala El Koubra" in "Gharbia" Governorate. In both locations, a 175 $m^2$ (1 Karat) area was divided into three equally sized plots for four cotton plants growing, three treatments were used, treatment A for dustable powder formulation F2 for compound (2a), treatment B for dustable powder formulation F3 for compound (2b) and treatment C for (Check control). Each plot had nine ridges that were separated into three replicates that were each five meters long and spaced 60 cm apart. All customary cultural techniques, such as weeding, irrigation, and land preparation, were carried out, and no insecticides were used. On top of the ridgeson, cotton seeds were planted on April 5, 2020, in a single row, about 2-3 cm deep. The following treatments were sprayed: One spray only to the end of the season (treatments spray once and data are recorded until the end of the season). Two sprays to the end of the season with 15 days between each spray, the first spray when the flowers start to appear and the second spray when the bolls were formed, while the examination and data recording remain until the cotton is harvested (Ali I.N. Abdel-Aal 2004).

**3. Cotton Properties:**

**3.1 Cotton Yield:**

The cotton yield as a result of all previously mentioned treatments was estimated to ascertain the impacts of the application of treatments on the yield as the work's ultimate objective. By manually comparing each treatment to the control check, the cotton yield was calculated and reported in accordance with Kantar/fed. (Said *et al.*, 2011)

**3.2 Fiber Properties:**

Some fiber technological characteristics were measured at the Cotton Technology Research Division of the Cotton Research Institute in Giza, Egypt, at a constant relative humidity of 65% (± 2) and temperature of 21 ºC (± 2). Micronaire value, Fiber maturity ratio, Upper half means length (UHML), length uniformity index (%), Short fiber index (SFI), fiber strength (g/tex), and fiber elongation percentage (%) were all determined by the HVI instrument system (A.S.T.M., D:4605-1986.). While oil percentage was determined using soxhlet apparatus according to AOAC (2004)**.**

**4. Statistical Analysis:**

According to the method outlined by Gomez and Gomez (1984) the analysis of variance was conducted. The statistical software package MSTAT-C was used to evaluate the data statistically (Freed, 1991). The least significant difference (L.S.D.) test was applied at the 0.05 level to compare means in cases where the F-test revealed significant differences between treatment means. According to Henderson and Tilton's formula (1955), the reduction rate was calculated in the manner described below:

Reduction % = (1 - (B.I. % in Co. before treatment) X (B.I. % in T after treatment) / (B.I. % in Co. after treatment) X (B.I. % in T before treatment) * 100

Where: B.I. % = boll infestation %, T = treated, Co. = control

## RESULTS AND DISCUSSION

**Biological Part:**

The percentage of infestation during the (2020) season in the two governorates under research, Qalubia and Gharbia, was displayed in Table (1). Inspection findings in the Qalubia Governorate revealed four generations of *P. gossypiella*, with the third generation reaching its peak on September 8$^{th}$ with 39.3% of individuals and an average temperature and relative humidity of 31 ºC, respectively. *E. insulana* recorded four generations, with the first of September being the peak with 39.1% of individuals, which corresponds to average temperatures and relative humidity levels of 29.7 ºC and 70.2%, respectively with a mean average temperature and average relative humidity of 28.48 ºC and 74.85%, respectively,

during this season, *P. gossypiella* individual's means were 16.99% and 19.90% for *E. insulana*. In the Gharbia governorate, four generations of *P. gossypiella* were estimated, with the peak occurring on September 8th at 34.5% relative to the average temperature and average relative humidity of 29.9 ºC and 62.5%, respectively. Four generations of *E. insulana* were also recorded, with the peak occurring at the beginning of September at 28.8% relative to the average temperature and average relative humidity of 30.3 ºC and 62.5%, respectively. For *P. gossypiella* and *E. insulana*, the reported mean during this season was 14.3 and 15.2%, respectively, in relation to the mean average temperature and average relative humidity of 33.39 ºC and 56.46%, respectively. The maximum peak for both pests under consideration was recorded at the same time in both governorates with only a small variation in temperature and relative humidity (Dhaka and Pareek, 2008); El-Gabaly, 2008).

**Table 1** Percentage of infestation of *P. gossypiella* and *E. insulana* with temperature and humidity in Gharbia and Qalyubia governorates during the 2020/2021 season.

| Inspection date | Percentage of infestation (2020) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Qalubia | | | | Gharbia | | | |
| | *P. gossypiella* | *E. insulana* | Average of Temp.(°C) | Average of R.H. (%) | *P. gossypiella* | *E. insulana* | Average of Temp.(°C) | Average of R.H. (%) |
| 13thJun. | 3.0 | 5.1 | 23.0 | 65.1 | 1.6 | 3.3 | 28.7 | 34.9 |
| 20thJun | 4.3 | 6.1 | 24.0 | 65.0 | 2.0 | 5.2 | 28.8 | 47.0 |
| 27thJun | 8.5 | 14.5 | 30.8 | 67.0 | 7.3 | 11.3 | 28.7 | 53.1 |
| 4thJul. | 10.9 | 11.5 | 25.0 | 66.0 | 9.5 | 10.0 | 30.6 | 51.1 |
| 11th Jul. | 7.3 | 9.3 | 27.0 | 67.0 | 5.6 | 8.9 | 29.6 | 59.4 |
| 18th Jul. | 8.1 | 17.1 | 28.0 | 70.0 | 7.6 | 14.4 | 28.1 | 59.6 |
| 25th Jul. | 19.4 | 14.1 | 28.5 | 71.0 | 13.6 | 12.1 | 29.8 | 61.8 |
| 2nd Aug. | 16.0 | 15.3 | 28.7 | 71.3 | 9.1 | 13.4 | 31.1 | 55.0 |
| 9thAug. | 27.3 | 32.1 | 30.5 | 71.0 | 22.1 | 20.9 | 30.3 | 59.0 |
| 16th Aug. | 29.9 | 30.9 | 29.5 | 71.1 | 24.3 | 18.0 | 29.7 | 59.7 |
| 24th Aug. | 23.1 | 32.5 | 29.0 | 70.0 | 16.9 | 26.4 | 30.1 | 58.3 |
| 1stSept. | 34.9 | 39.3 | 29.7 | 70.2 | 30.1 | 28.8 | 30.3 | 62.5 |
| 8th Sept. | 39.3 | 35.5 | 31.0 | 73.0 | 34.5 | 25.9 | 29.9 | 62.5 |
| 15th Sept. | 17.8 | 20.3 | 30.5 | 75.0 | 14.2 | 15.3 | 30.0 | 60.2 |
| 23rd Sept. | 12.8 | 20.0 | 30.0 | 75.5 | 14.2 | 14.5 | 29.2 | 59.7 |
| 30th Sept. | 12.0 | 15.0 | 30.5 | 75.0 | 12.0 | 12.0 | 29.2 | 59.7 |
| Total | 271.9 | 318.49 | 455.7 | 1197.7 | 224.6 | 240.4 | 534.3 | 903.5 |
| Mean | 16.99 | 19.90 | 28.48 | 74.85 | 14.03 | 15.02 | 33.39 | 56.46 |

In Qalubia and Gharbia governorates during the 2021-2022 seasons, Table (2) displayed the proportion of infestation of *P. gossypiella* and *E. insulana* in relation to average temperature and average relative humidity. *P. gossypiella* was recorded in Qalubia, where it produced 4 generations, with a peak of 39.3% individuals on September 7th in relation to an average temperature of 31 ºC and an average humidity of 63%. *E. insulana* also displayed four generations, with the peak occurring at the end of August with a relative humidity of 61% and a temperature of 32 ºC. For both pests under study, approximately the same number of generations was seen in the governorates of Gharbia and Qalubia. In addition, the peaks of *P. gossypiella* and *E. insulana* were detected in both governorates at the end of August and the seventh of September, respectively. In general, *P. gossypiella* and *E. insulana* infestation percentages in Qalubia were 17.84 and 20.25%, respectively, in relation to mean average temperature and mean average relative humidity of 29 ºC and 56.38%, while in Gharbia they were 14.6 and 15.27%, respectively, in relation to mean average temperature and mean average relative humidity of 29.67 ºC and 49.2%.

**Table 2:** Percentage of infestation of *P. gossypiella* and *E. insulana* with temperature and humidity in Gharbia and Qalyubia governorates during the 2021/2022 season.

| Inspection date | Percentage of infestation (2021) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Qalubia | | | | Gharbia | | | |
| | *P. gossypiella* | *E. insulana* | Average of Temp. (°C) | Average of R.H. (%) | *P. gossypiella* | *E. insulana* | Average of Temp. (°C) | Average of R.H. (%) |
| 14th. June | 3.0 | 5.1 | 25.0 | 60.0 | 1.6 | 3.3 | 30.7 | 50.1 |
| 21st. June | 4.3 | 6.1 | 26.0 | 52.0 | 2.0 | 5.2 | 28.0 | 47.5 |
| 28th. June | 8.5 | 14.5 | 28.0 | 58.0 | 7.3 | 11.3 | 27.8 | 47.0 |
| 5th. July | 10.9 | 11.5 | 29.0 | 49.0 | 9.5 | 10.0 | 27.9 | 46.0 |
| 12th.July | 7.3 | 9.3 | 28.0 | 52.0 | 5.6 | 8.9 | 26.0 | 51.5 |
| 19th. July | 8.1 | 17.1 | 29.0 | 49.0 | 7.6 | 14.4 | 29.0 | 46.5 |
| 26th. July | 19.4 | 14.1 | 29.0 | 56.0 | 13.6 | 12.1 | 28.0 | 48.0 |
| 2nd. August | 16.0 | 15.3 | 33.0 | 57.0 | 9.1 | 13.4 | 31.0 | 53.0 |
| 11st. August | 27.3 | 32.1 | 30.0 | 54.0 | 22.1 | 20.9 | 31.0 | 47.0 |
| 18th. August | 29.9 | 30.9 | 29.0 | 57.0 | 24.3 | 18.0 | 32.0 | 58.0 |
| 23rd. August | 23.1 | 32.5 | 28.0 | 65.0 | 16.9 | 26.4 | 31.8 | 50.0 |
| 30th. August | 34.9 | 39.3 | 32.0 | 61.0 | 30.1 | 28.8 | 30.0 | 59.0 |
| 7th.September | 39.3 | 35.5 | 31.0 | 63.0 | 34.5 | 25.9 | 33.4 | 46.0 |
| Total | 232 | 263.3 | 377 | 733 | 184.2 | 198.6 | 385.8 | 639.6 |
| Mean | 17.84 | 20.25 | 29 | 56.38 | 14.6 | 15.27 | 29.67 | 49.2 |

On *P. gossypiella* employing a single spray in the governorates of Gharbia and Qalyubia during the 2020-2021 season, Table (3) showed the biological efficacy of compounds 2a and 2b as dustable powders F2 and F3, respectively. After the first two weeks of treatment, formulation F2 in the Qalubia governorate showed reduced rates of 67.00 and 70.30, respectively, with a mean reduction rate of 68.65 in the continuation of treatment to the end of the season. It also demonstrated a direct increase in reduction rate with the lengthening of the treatment period, with a mean reduction rate of 73.12 at the end of the season. Even though F3 had a considerable reduction rate, fluctuations were seen since it showed an inverse relationship between the reduction rate and the treatment period. After each week of treatment, the reduction rate declined steadily with the exception of the third week, which had the highest reduction rate. At the end of the season, a mean reduction rate of 54.15 was found. Similar results were attained in the Gharbia governorate. As their values were 70.30 and 73.00, with a mean reduction rate of 71.65, for the first two weeks following the first spray, F2 demonstrated a straight increase in the reduction rate with the prolonging of the treatment period. Additionally, a similar relationship was seen between the reduction rate and the length of treatment (Mini Ali I.N. Abdel-Aal 2004), which resulted in a final mean reduction rate of 64.80. After the first two weeks of treatment, F3 displayed similar reduction rate values of 67.00 and 66.00 with a mean reduction rate of 66.5. After the season is over the reduction rates were 50.40, 52.50, 54.00, and 55.00 after the third, fourth, fifth, and sixth weeks of treatment, respectively, with a mean reduction rate of 52.97. This indicates that the reduction rate gradually increased with the period of treatment. In Gharbia and Qalyubia governorates during this season under field conditions, F2 dustable powder formulation was generally much more effective in controlling *P. gossypiella* on using one spray; this was supported by the calculated general mean of reduction rate, which was 70.88, 68.22 for F2 and 57.50, 59.73 for F3 in Qalyubia and Gharbia, respectively.

**Table 3:** Effect of dustable powder formulations in controlling *P. gossypiella* on using one spray in Gharbia and Qalyubia governorates during the 2020/2021 season under Field Conditions.

| Formulation | Reduction rate | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Qalubia | | | | | | | | | Gharbia | | | | | | | | |
| | First spray | | Mean | To the end of the season | | | | Mean | G.M | First spray | | Mean | To the end of the season | | | | Mean | G.M |
| | 1st week | 2nd week | | 3rd | 4th | 5th | 6th | | | 1st week | 2nd week | | 3rd week | 4th week | 5th week | 6th week | | |
| **F2** | 67.00 | 70.30 | **68.65** | 71.50 | 73.00 | 73.00 | 75.00 | **73.12** | **70.88** | 70.30 | 73.00 | **71.65** | 57.90 | 65.30 | 66.00 | 70.00 | **64.8** | **68.22** |
| **F3** | 61.60 | 60.10 | **60.85** | 70.30 | 55.40 | 50.90 | 40.00 | **54.15** | **57.5** | 67.00 | 66.00 | **66.5** | 50.40 | 52.50 | 54.00 | 55.00 | **52.97** | **59.73** |
| **Con.** | 91.30 | 98.30 | 94.8 | 97.90 | 99.90 | 100.00 | 100.00 | 99.45 | 97.12 | 85.90 | 90.00 | 87.95 | 99.30 | 99.90 | 100.00 | 100.00 | 99.8 | 93.87 |

In the governorates of Gharbia and Qalyubia during the 2021–2022 seasons, **T**able (4) demonstrated the biological effectiveness of dustable powders F2 and F3 against *P. gossypiella* with a single spray under field conditions. In the Qalubia governorate, F2 showed an increase in the reduction rate following the first two weeks of treatment; their respective reduction rates were 50.00 and 57.00, with a mean reduction rate of 53.50. The reduction rates after 3-, 4-, 5-, and 6-weeks following treatment, respectively, were 71.50, 73.00, 73.90, and 75.00, with a mean reduction rate of 73.35. These results revealed a direct proportion between the reduction rate and the period of treatment to the end of the season.

Dustable powder formulation F3 also revealed a direct correlation between the reduction rate and the period of treatment either after the first two weeks from treatment or after 3, 4, 5 and six weeks from treatment to the end of the season. Its reduction rate was 55.00 and 60.00 after the first two weeks of treatment, with mean reduction rates of 63.25 and 60.00, 62.00, 65.00, and 66 after 3, 4, 5, and six weeks of treatment until the end of the season. In the Gharbia Governorate, F2 and F3 likewise showed a direct correlation between the reduction rates and the treatment period, either after the first two weeks of treatment or after 3, 4, 5, and 6 weeks of treatment until the end of the season. F3 exhibited 47.00 and 50.00 after the same time of treatment, with a mean reduction rate of 48.50, while F2 showed 63.00 and 65.00 after the first two weeks with a mean reduction rate of 64.00. Additionally, F2 demonstrated reduced rates of 57.00, 60.00, 63.00, and 65.00 after 3, 4, 5, and six weeks from treatment to the end of the season, with a mean reduction rate of 61.47, while F3 demonstrated reduced rates of 51.00, 51.50, 52.00, and 55.00 with a mean reduction rate of 52.37 following the same period of treatment. In both governorates under study, the general mean reduction rate for F2 was higher than that for F3; it was 63.42 and 62.73 for F2, compared to 60.37 and 50.43 for F3. These results supported the previous season's findings that dustable powder formulation F2 was significantly more efficient than dustable powder formulation F3 (Hamouda *et al.*, 2022).

**Table 4:** Effect of dustable powder formulations in controlling *P. gossypiella* on using one spray in Gharbia

| Formulation | Reduction rate | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Qalubia | | | | | | | | | Gharbia | | | | | | | | |
| | First spray | | Mean | To the end of the season | | | | Mean | G.M | First spray | | Mean | To the end of the season | | | | Mean | **G.M** |
| | 1st week | 2nd week | | 3rd week | 4th week | 5th week | 6th week | | | 1st week | 2nd week | | 3rd week | 4th week | 5th week | 6th week | | |
| **F2** | 50.00 | 57.00 | **53.5** | 71.50 | 73.00 | 73.90 | 75.00 | **73.35** | **63.42** | 63.00 | 65.00 | **64.00** | 57.90 | 60.00 | 63.00 | 65.00 | **61.47** | **62.73** |
| **F3** | 55.00 | 60.00 | **57.5** | 60.00 | 62.00 | 65.00 | 66.00 | **63.25** | **60.37** | 47.00 | 50.00 | **48.50** | 51.00 | 51.50 | 52.00 | 55.00 | **52.37** | **50.43** |
| **Con.** | 80.00 | 88.00 | 84.00 | 88.00 | 90.00 | 90.00 | 100.00 | 92.00 | 88.00 | 79.00 | 80.00 | 79.50 | 80.00 | 90.00 | 100.00 | 100.00 | 92.50 | 86.00 |

Table (5) displayed the results of two sprays of the two chromen dustable powder

formulations against *P. gossypiella* throughout the 2020–2021 growing season in the governorates of Gharbia and Qalyubia.F2 in the Qalubia governorate showed roughly the same reduction rates of 40.00 and 41.00 after the first two weeks following the first spray, with a mean reduction rate of 40.50 and 43.00, and 40.00 after the third and fourth weeks following the second spray, with mean reduction rates of 41.50 and 41.00, respectively, until the end of the season. Additionally, F3 provided comparable reduction rates, providing 33.00 and 30.00 after the first two weeks of the first spray with mean reduction rates of 31.50 and 20.50, 20.00 after the second two weeks of the second spray, and relatively the same reduction rates of 21.00 and 22.00 to the end of the season with mean reduction rates of 21.50. Similar outcomes were attained in the Gharbia Governorate. After the first two weeks from the first spray, F2 showed 33.00 and 30.00, with mean reduction rates of 31.50 and 30.00, 28.00 after the second two weeks from the second spray, with mean reduction rates of 29.00 and 30.00, and 30.50 after the third two weeks from the second spray to the end of the season, with a mean reduction rate of 29.1. Dustable powder F3 demonstrated reduced rates of 30.00 and 20.00 after the first weeks from the first spray with mean reduction rates of 25.00 and 20.00, 18.00 after the two second weeks from the second spray with mean reduction rates of 19.00 and 25.00, and 22.75 after the third two weeks from the second spray with a mean reduction rate of 22.25. In general, F2 was much more efficient than F3. The results were derived from the mean reduction rates in the two governorates under examination. For F2 and F3 respectively, the general mean reduction rate was 27.18, 24.42 in the Qalubia governorate, and 29.91, 22.25 in the Gharbia, governorate.

**Table 5:** Effect of dustable powder formulations in controlling *P. gossypiella* on using two sprays in Gharbia and Qalyubia governorates during the 2020/2021 season under field Conditions.

| Formulation | Reduction rate | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Qalubia | | | | | | | | | | Gharbia | | | | | | | | | |
| | First spray | | | Second spray | | | To the end of the season | | | G.M | First spray | | | Second spray | | | To the end of the season | | | G.M |
| | Weeks | | | | | | | | | | Weeks | | | | | | | | | |
| | 1st | 2nd | Mean | 3rd | 4th | Mean | 5th | 6th | Mean | | 1st | 2nd | Mean | 3rd | 4th | Mean | 5th | 6th | Mean | |
| **F2** | 40.0 | 41.00 | **40.50** | 43.00 | 40.00 | 41.5 | 41.0 | 41.00 | **41.00** | **27.18** | 33.00 | 30.00 | **31.5** | 30.00 | 28.00 | 29.0 | 30.00 | 30.50 | **30.25** | **29.91** |
| **F3** | 33.0 | 30.00 | **31.5** | 20.50 | 20.00 | 20.25 | 21.00 | 22.000 | **21.5** | **24.42** | 30.00 | 20.00 | **25.00** | 20.0 | 18.0 | 19.0 | 20.5 | 25.0 | **22.75** | **22.25** |
| **Con.** | 90.0 | 95.00 | 92.5 | 95.00 | 98.00 | 96.5 | 100/00 | 100/00 | 100.0 | 96.33 | 90.00 | 95.00 | 92.5 | 95.00 | 95.00 | 100.0 | 100.00 | 98.010 | 99.00 | 95.5 |

In the governorates of Gharbia and Qalyubia during the 2021-2022 seasons, Table (6) displayed the biological effects of the two dustable powder formulations, F2 and F3, on *P. gossypiella* when applied in two sprays. According to the results obtained in the Qalubia Governorate, F2 provided reduction rates of 30.00 and 29.00 after the first two weeks following the first spray, with a mean reduction rate of 29.50; 25.00 after the second two weeks following the second spray, with the same mean reduction rate; and 25.00, 30.00 after the third and fourth weeks following the second spray, with a mean reduction rate of 27.50 till the end of the season. F3 demonstrated reduced rates of 25.00 and 21.00 after the first two weeks of the first spray, with mean reduction rates of 23.00 and 18.00, 17.00 after the second and third weeks of the second spray, with mean reduction rates of 18.50 and 18.00, and 19.00 after the third and fourth weeks of the second spray, with mean reduction rate 18.5 to the end of the season. In the governorate of Gharbia, F2 showed 40.00 and 35.00 after the first and second weeks following the first spray, respectively, with mean reduction rates of 37.50 and 35.00, 30.00 after the second and third weeks following the second spray, respectively, with mean reduction rates of 32.50 and 33.00, and 45.00 after the third and fourth weeks following the second spray.F3 showed 20.00, 17.00 reduction rates after the first two weeks, with a mean reduction rate of 18.5; 15.00, 13.00 after the second and third

weeks from the second spray, with a mean reduction rate of 14.00; and 15.00 after the fourth and fifth sprays from the second spray, with the same value as the mean reduction rate to the end of the season. Even with two sprays, F2 was still more efficient than F3, with general mean reduction rates of 27.33, 34.66 for F2 and 19.66, 15.83 for F3 in the governorates of Qalyubia and Gharbia, respectively.

**Table 6**: Effect of dustable powder formulations in controlling *P. gossypiella* on using two sprays in Gharbia and Qalyubia governorates during the 2021/2022 season under field Conditions.

| Formulation | Reduction rate | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Qalubia | | | | | | | | | | Gharbia | | | | | | | | | |
| | First spray | | | Second spray | | | To the end of the season | | | G.M | First spray | | | Second spray | | | To the end of the season | | | G.M |
| | Weeks | | | | | | | | | | Weeks | | | | | | | | | |
| | 1st | 2nd | Mean | 3rd | 4th | Mean | 5th | 6th | Mean | | 1st | 2nd | Mean | 3rd | 4th | Mean | 5th | 6th | Mean | |
| F2 | 30.00 | 29.00 | **29.5** | 25.00 | 25.00 | **25.00** | 25.00 | 30.00 | **27.5** | **27.3** | 40.00 | 35.00 | **37.5** | 35.00 | 30.00 | **32.5** | 33.00 | 35.00 | **34.00** | **34.66** |
| F3 | 25.00 | 21.00 | **23.00** | 18.00 | 17.00 | **17.50** | 18.00 | 19.00 | **18.50** | **19.6** | 20.00 | 17.00 | **18.50** | 15.0 | 13.0 | **14.00** | 15.00 | 15.00/. | **15.00** | **15.83** |
| Con. | 90.0 | 95.00 | 92.50 | 97.00 | 98.00 | 97.5 | 100/0 | 100/0 | 100.0 | 96.6 | 91.00 | 93.00 | 92.00 | 97.00 | 99.00 | 100.00 | 100.00 | 100.00 | 100.0 | 96.66 |

Dustable powder formulations F2 and F3 contained different chemical substituents and were also tested on *E. insolana* by using one spray in Qalyubia and Qalyubia governorates during the 2020/2021 season under field Conditions Table (7). F2 demonstrated reduced rates of 35.00 and 30.00 after the first two weeks following the first spray, and these rates grew to 35.00, 45.00, 50.00, and 60.00 after the third, fourth, fifth, and sixth weeks following the first spray, with a mean reduction rate of 47.62. In the Qalubia governorate, F3 produced 35.00 and 29.00 during the first two weeks of spraying with a mean reduction rate of 32.00, and the reduction rate increased from 30.00 to 35.00 following the first spray until the end of the season with a mean reduction rate of 32.75. In Gharbia Governorate, roughly the same data were obtained; F2 showed 40.00 after the first and second weeks following the first spray with the same value as the mean reduction rate, and the reduction rate increased from 43.00 to 50.00 during the following four weeks after the first spray with the mean reduction rate 47.00 till the end of the season. After the first two weeks from the first spray, F3 also showed reduced rates of 37.5 and 33.00, with a mean reduction rate of 33.50. After the following four weeks from the first spray to the end of the season, the reduction rate increased to 35.00 from 31.5, with a mean reduction rate of 33.37. When the general mean reduction rate was taken into account, F2 in both Governorates reported a general mean reduction rate that was higher than F3, showing higher efficacy.

**Table 7:** Effect of dustable powder formulations in controlling *E. insolana* on using one spray in Gharbia and Qalyubia governorates during the 2020/2021 season under field Conditions.

| Formulation | | Reduction rate | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Qalubia | | | | | | | | | Gharbia | | | | | | | |
| | First spray | | | To the end of the season | | | | | | First spray | | | To the end of the season | | | | | |
| | 1st week | 2nd week | Mean | 3rd week | 4th week | 5th week | 6th week | Mean | G.M | 1st week | 2nd week | Mean | 3rd week | 4th week | 5th week | 6th week | Mean | G.M |
| F2 | 35.00 | 30.00 | **32.5** | 35.50 | 45.00 | 50.00 | 60.00 | **47.62** | **40.06** | 40.00 | 40.00 | **40.00** | 43.00 | 45.00 | 50.00 | 50.00 | **47.00** | **43.5** |
| F3 | 35.00 | 29.00 | **32.00** | 30.00 | 33.00 | 33.00 | 35.00 | **32.75** | **32.37** | 37.00 | 30.00 | **33.5** | 31.00 | 33.50 | 34.00 | 35.00 | **33.37** | **33.43** |
| Con. | 70.30 | 78.30 | 74.30 | 80.00 | 80.00 | 90.00 | 100.00 | 87.5 | 80.9 | 80.00 | 90.00 | 85.00 | 90.00 | 90.00 | 100.00 | 100.00 | 95.00 | 90.00 |

In the governorates of Gharbia and Qalyubia during the 2021–2022 season, Table (8) showed the impact of dustable powder formulations on *E. insolana* with one spray. In Qalubia governorate, following the first spray, formulation F2 demonstrated reduction rates of 40 and 43, respectively, with a mean reduction rate of 41.50while the reduction rate grew

from 45.50 to 46.00 to 47.00 to 50.00 after three, four, five, and six weeks from the first spray with a mean reduction rate of 47.12 to the end of the season, a direct correlation had been seen between the reduction rate and the extension of the treatment period. After the first two weeks from the first spray with a mean reduction rate of 39.00, F3 declared 40.00 and 38.00 reduction rates. The effect remained largely unchanged after the following three weeks (35.00), and it showed a relative change to 37.00 after the fourth week from the first spray with a mean reduction rate of 35.50 to the end of the season. In the Gharbia governorate, F2 produced reduction rates of 50.00 and 45.00 after the first and second weeks of the first spray, respectively, with a mean reduction rate of 47.50. The effect then changed from 47.00 after the following two weeks to 48.00 and 53.00 after the fifth and sixth weeks of the first spray to the end of the season, respectively, with a mean reduction rate of 48.75. Similarly to the Qalubia governorate, F2 showed reduced rates of 40.00 and 36.00 after the first two weeks following the first spray, with a mean reduction rate of 38.00. The reduction rate increased from 36.00 to 38.00 after the additional four weeks from the first spray to the end of the season as a result of extending the treatment period. Similar to the previous season, F2 once more proved to be significantly more effective than F3, as evidenced by the general mean of the reduction rate, which was higher in the case of F2 than in the case of F3 in both Governorates under examination.

**Table 8:** Effect of dustable powder formulations in controlling *E. insolana* on using one spray in Gharbia and Qalyubia governorates during the 2021/2022 season under field Conditions.

| Formulation | Reduction rate | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Qalubia | | | | | | | | | Gharbia | | | | | | | | |
| | First spray | | Mean | To the end of the season | | | | Mean | G.M | First spray | | Mean | To the end of the season | | | | Mean | G.M |
| | 1st week | 2nd week | | 3rd week | 4th week | 5th week | 6th week | | | 1st week | 2nd week | | 3rd week | 4th week | 5th week | 6th week | | |
| **F2** | 40.00 | 43.00 | **41.50** | 45.50 | 46.00 | 47.00 | 50.00 | **47.12** | **44.31** | 50.00 | 45.00 | **47.50** | 47.00 | 47.00 | 48.00 | 53.00 | **48.75** | **48.12** |
| **F3** | 40.00 | 38.00 | **39.00** | 35.00 | 35.00 | 35.00 | 37.00 | **35.50** | **37.25** | 40.00 | 36.00 | **38.00** | 36.00 | 37.00 | 38.00 | 38.00 | **37.25** | **37.62** |
| **Con.** | 70.30 | 78.30 | 74.30 | 80.00 | 80.00 | 90.00 | 100.00 | 87.50 | 80.90 | 80.00 | 90.00 | 85.00 | 90.00 | 90.00 | 100.00 | 100.00 | 95.00 | 90.00 |

In Gharbia and Qalyubia governorates during the 2020–2021 season, two sprays were used to test the effectiveness of two dustable powder formulations based on synthetic chromen compounds on *E. insolana*. The results are shown in Table (9) under field conditions. F2 provided reduction rates of 50.00 and 49.00 % in the Qalubia governorate after the first two weeks from the first spray, with a mean reduction rate of 49.75, following the second spray it provided reduction rates of 50.00 and 45.00 after the third and fourth weeks, with a mean reduction rate of 47.50, relatively the same reduction rates were estimated after the fifth and the sixth week from the second spray with a mean reduction rate of 45.50. F3 displayed relatively similar values throughout all treatment periods; it showed 45.5 and 41.00following the first two weeks after the first spray with a mean reduction rate of 43.25; 40.50, 39.00 following the second two weeks after the second spray with a mean reduction rate of 39.75; and 40.00, 42.00 after the third two weeks following the second spray to the end of the season with a mean reduction rate of 42.00. In the Gharbia Governorate, F3 showed a 51.00 and 50.00 reduction rate with a mean reduction rate of 50.50 after the first two weeks from the first spray, a 50.00, 43.00 reduction rate after the second two weeks from the second spray with a mean reduction rate of 47.50, and a 33.5, 25.00 reduction rate after the third two weeks from the second spray with a mean reduction rate of 29.25. F2 showed relatively lower reduction rates than F3 for the first four weeks. In comparison to F3, which showed a reduced rate of 33.00, 33.50 with a mean reduction rate

of 31.75 at the end of the experiment, F2 showed reduced rates of 40.00 and 38.00 after the first two weeks, with mean of 39.00 and 35.00, 33.00 after the second two weeks following the second spray, and returned back to afford a greater rate of reduction.

Table 9: Effect of dustable powder formulations in controlling *E. insolana* on using two sprays in Gharbia and Qalyubia governorates during the 2020/2021 season under field Conditions.

| Formulation | Reduction rate | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Qalubia | | | | | | | | | | Gharbia | | | | | | | | | |
| | First spray | | | Second spray | | | To the end of the season | | | G.M | First spray | | | Second spray | | | To the end of the season | | | G.M |
| | Weeks | | | | | | | | | | Weeks | | | | | | | | | |
| | 1st | 2nd | Mean | 3rd | 4th | Mean | 5th | 6th | Mean | | 1st | 2nd | Mean | 3rd | 4th | Mean | 5th | 6th | Mean | |
| F2 | 50.00 | 49.50 | **49.75** | 50.00 | 45.00 | **47.50** | 45.0 | 46.00 | **45.5** | **47.5** | 40.00 | 38.00 | **39.00** | 35.00 | 33.00 | **34.00** | 33.00 | 30.50 | **31.75** | **34.91** |
| F3 | 45.5 | 41.0 | **43.25** | 40.50 | 39.00 | **39.75** | 40.00 | 42.00 | **41.00** | **41.3** | 51.00 | 50.00 | **50.50** | 50.0 | 43.0 | **47.50** | 33.5 | 25.0 | **29.25** | **42.41** |
| Con. | 90.5 | 95.6 | 93.05 | 97.2 | 98.8 | 98.00 | 100/00 | 100/0 | 100.00 | 97.0 | 91.30 | 98.30 | 93.3 | 97.90 | 99.00 | 100.00 | 100.00 | 98.0 | 99.00 | 96.91 |

Table (10) shows the biological activity of the newly prepared dustable powder formulations against *E. insolana* utilizing two sprays throughout the 2021–2022 season in the governorates of Gharbia and Qalyubia. According to all previously reported results, F2 was more effective than F3 in the Qalubia governorate, providing reduction rates of 50.00, 49.00 after the first two weeks following the first spray, 50.00, 45.00 after the second two weeks following the second spray, and 45.00, 46.00 after the third two weeks following the second spray to the end of the season, with a mean reduction rate of 45.50. Dustable powder formulation F3 demonstrated a 45.50, 41.00 reduction rate following the first two weeks after the first spray, with a mean reduction rate of 43.25; 40.50, 39.00 following the second two weeks after the second spray, with a mean reduction rate of 39.75; and 40.00, 42.00 following the third two weeks after the second spray to the end of the season, with a mean reduction rate of 41.00. F3 showed much greater levels of efficacy than F2 in Gharbia Governorate. After the first two weeks from the first spray, Formulation F3 showed 51.20, 50.20 with a mean reduction rate of 50.65 and 50.40, 43.20 after the second two weeks from the second spray with mean reduction rates of 46.80 and 33.50, and 25.60 after the third two weeks from the second spray to the end of the season with a mean reduction rate of 29.55. After the first two weeks, dustable powder formulation F3 produced 40.00, a 38.00 reduction rate with a mean of 39.00 and 35.00, a 33.00 reduction rate after the second two weeks following the second spray with a mean of 34.00 and a 33.00 reduction rate, and a 30.50 reduction rate after the third two weeks following the second spray to the end of the season with a mean reduction rate of 31.75.

**Table 10:** Effect of dustable powder formulations in controlling *E. insolana* on using two sprays in Gharbia and Qalyubia governorates during the 2021/2022 season under field Conditions

| Formulation | Reduction rate | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Qalubia | | | | | | | | | | Gharbia | | | | | | | | | |
| | Firsts pray | | | Second spray | | | To the end of the season | | | G.M | First spray | | | Second spray | | | To the end of the season | | | G.M |
| | Weeks | | | | | | | | | | Weeks | | | | | | | | | |
| | 1st | 2nd | Mean | 3rd | 4th | Mean | 5th | 6th | Mean | | 1st | 2nd | Mean | 3rd | 4th | Mean | 5th | 6th | Mean | |
| F2 | 50.00 | 49.50 | **49.75** | 50.00 | 45.00 | **47.50** | 45.0 | 46.00 | **45.50** | **47.25** | 40.00 | 38.00 | **39.00** | 35.00 | 33.00 | **34.00** | 33.00 | 30.50 | **31.75** | **34.91** |
| F3 | 45.5 | 41.0 | **43.25** | 40.50 | 39.00 | **39.75** | 40.00 | 42.00 | **41.00** | **41.33** | 51.2 | 50.1 | **50.65** | 50.4 | 43.2 | **46.8** | 33.5 | 25.6 | **29.55** | **42.33** |
| Con. | 90.5 | 95.6 | 93.05 | 97.2 | 98.8 | 98.00 | 100/00 | 100/00 | 100.00 | 97.01 | 91.30 | 98.3 | 93.8 | 97.90 | 99.90 | 98.90 | 100.00 | 98.3 | 99.15 | 97.28 |

**Fiber Properties:**

The findings in Tables (11-13) revealed that the mean values of some fiber properties parameters, including micronaire value, fiber maturity ratio, upper half mean length (mm), length uniformity index (%), short fiber index, fiber strength (g/tex), fiber elongation percentage (%), and oil percentage, for Egyptian cotton cv. Giza 96 extra-long staple and G 94 long staple during the 2020 and 2021 seasons were influenced by varieties, spray, location, and interaction.

**Effect of Location:**

Some of the measured fiber characteristics parameters, including maturity, fiber strength (g/tex), and oil %, were significant. Location b provided the greatest values for maturity (0.90 and 0.92), fiber strength (44.51 and 44.90), and oil %. (18.87 and 19.22).

**Effect of Verity:**

In the first and second seasons, respectively, G 96 earned the greatest mean values for upper half mean length (35.50 and 35.02 mm), fiber strength (45.77 and 45.90 g/tex.), micronaire value (3.45 and 3.75), and fiber maturity ratio (0.88 and 0.91). The lowest mean values of the short fiber index (6.30 and 7.10), elongation % (6.64 and 7.41), and oil percentage (18.61 and 18.99), respectively, were the lowest in both seasons.

**Effect of Dustable Powder:**

In both seasons, A2 provided the best micronaire value (3.5 and 3.57) and the greatest value of fiber strength (44.21 and 45.12). The highest value of (0.90) was only achieved in 2021. Other significant values included the upper half mean (34.00 and 34.22), short fiber index (7.02 and 7.9), and oil percentage (19.08 and 19.99) for both seasons.

**effect of the Interaction:**

The results showed that the interaction between location and the dustable powder formulations F2 and F3 during the 2020 and 2021 seasons had a significant impact on some fiber properties, including mean values of micronaire value, maturity, short fiber index, fiber strength (g/tex), and fiber elongation (%). The interaction during the two seasons did not significantly change the mean values of the upper half mean length (UHML), length uniformity index, or oil percentage (%).

Results demonstrated that, in 2020, only when mean values for all traits were unaffected, the interaction between location and variety generated the maximum interaction values for fiber attributes variables including maturity ratio and strength. Additionally, it was demonstrated by the interaction between location and the variety of all features that fiber had no impact on the projected maturity ratio (%) in 2021.

The second-order interaction between location ×Varity showed no significance in all traits of fiber expected for fiber maturity ratio (%) in 2021 and fiber strength (g/tex) in two seasons. The second-order interaction between location ×Varity did not significantly affect the fiber strength (g/tex) in two seasons or the fiber maturity ratio (%) in 2021. Similar results were also reported by Saleem *et al*. (2010), Ali and Hameed (2011), Kotb (2012) and Yang *et al.* (2021).

**Table 11:** Effect of Location, cotton varieties and dustable powder on fiber quality characters as estimated by (HVI) during 2020 and 2021 season

| | | MIC | | Mat. | | Length. | | Unif. | | SFI | | STRength | | Elong | | Oil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 |
| Locate | **L1** | 3.56 | 3.81 | 0.89 | 0.91 | 33.69 | 34.28 | 85.50 | 86.65 | 6.58 | 7.20 | 44.21 | 44.90 | 6.85 | 7.40 | 18.50 | 19.12 |
| | **L2** | 3.65 | 3.83 | 0.90 | 0.92 | 34.06 | 34.36 | 58.65 | 86.72 | 6.66 | 7.04 | 44.51 | 44.84 | 6.91 | 7.85 | 18.87 | 19.02 |
| | **LSD** | NS | NS | 0.05 | 0.08 | NS | NS | NS | NS | NS | NS | 0.09 | 0.10 | NS | NS | 0.13 | 0.14 |
| variay | **96** | 3.45 | 3.75 | 0.88 | 0.91 | 35.50 | 35.02 | 85.50 | 86.64 | 6.30 | 7.20 | 45.77 | 45.90 | 6.64 | 7.41 | 18.61 | 18.99 |
| | **94** | 3.55 | 3.88 | 0.87 | 0.92 | 33.62 | 33.00 | 85.44 | 86.73 | 6.94 | 7.10 | 42.95 | 43.99 | 7.11 | 7.34 | 18.75 | 19.02 |
| | **LSD** | 0.05 | 0.05 | 0.05 | 0.08 | 0.20 | 0.18 | NS | NS | 0.07 | 0.09 | 0.09 | 0.10 | 0.07 | 0.10 | NS | NS |
| Spray | **Cont.** | 4.00 | 4.06 | 0.95 | 0.97 | 34.65 | 34.82 | 85.11 | 87.00 | 6.10 | 6.85 | 45.15 | 46.00 | 7.11 | 7.85 | 19.00 | 20.00 |
| | **a** | 3.52 | 3.82 | 0.87 | 0.90 | 34.00 | 34.22 | 85.42 | 86.47 | 7.02 | 7.90 | 43.71 | 44.17 | 6.89 | 7.14 | 19.08 | 19.99 |
| | **b** | 3.50 | 3.57 | 0.86 | 0.89 | 33.02 | 33.92 | 84.95 | 86.58 | 6.75 | 6.95 | 44.21 | 45.12 | 6.63 | 7.52 | 17.97 | 18.71 |
| | **LSD** | 0.07 | 0.06 | NS | 0.09 | 0.25 | 0.23 | NS | 0.12 | 0.09 | 0.11 | 0.11 | 0.12 | 0.09 | 0.13 | 0.16 | 0.17 |

Micronaire value (MIC), Fiber maturity ratio (Mat.), Upper half means length (UHML), length uniformity index (UI. %), Short fiber index (SFI %), fiber strength (Str. g/tex), and fiber elongation percentage (Elg %) and oil percentage

**Table12:** Effect of the first order interaction between location, verities, and dustable powder on fiber characters as estimated by (HVI) during 2020 and 2021.

| | | MIC | | Mat. | | Length. | | Unif. | | SFI | | STRength | | Elong | | Oil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 |
| GHR. | **96** | 3.72 | 3.99 | 0.90 | 0.92 | 35.01 | 35.52 | 86.57 | 87.23 | 6.28 | 7.08 | 45.75 | 46.14 | 6.66 | 7.01 | 18.50 | 19.14 |
| | **94** | 3.90 | 3.98 | 0.93 | 0.93 | 33.56 | 33.89 | 86.72 | 87.20 | 6.87 | 7.56 | 42.66 | 43.12 | 7.03 | 7.56 | 18.50 | 19.22 |
| Qua. | **96** | 3.78 | 3.90 | 0.93 | 0.94 | 35.03 | 35.55 | 86.71 | 87.02 | 6.32 | 7.18 | 45.78 | 46.52 | 6.62 | 7.11 | 18.73 | 19.27 |
| | **94** | 3.87 | 3.99 | 0.92 | 0.94 | 33.68 | 33.89 | 86.74 | 87.00 | 7.01 | 7.33 | 43.24 | 44.16 | 7.20 | 7.30 | 19.01 | 19.99 |
| GHR. | **Cont.** | 4.05 | 4.09 | 0.95 | 0.96 | 34.78 | 34.88 | 86.93 | 87.26 | 6.05 | 7.52 | 45.08 | 46.01 | 7.05 | 7.15 | 18.90 | 19.56 |
| | **a** | 3.83 | 3.98 | 0.90 | 0.92 | 34.23 | 34.86 | 86.43 | 87.52 | 7.03 | 7.14 | 43.50 | 44.13 | 6.91 | 7.01 | 18.90 | 19.52 |
| | **A1** | 3.55 | 3.59 | 0.90 | 0.91 | 33.85 | 33.95 | 86.58 | 86.95 | 6.66 | 7.00 | 44.05 | 45.02 | 6.58 | 7.00 | 17.70 | 18.75 |
| Qua. | **Cont.** | 4.08 | 4.10 | 1.00 | 1.00 | 34.86 | 34.99 | 87.08 | 87.29 | 6.15 | 7.02 | 45.23 | 46.20 | 7.18 | 7.41 | 19.10 | 20.10 |
| | **a** | 3.81 | 3.99 | 0.90 | 0.93 | 34.21 | 34.87 | 86.51 | 87.06 | 7.01 | 7.12 | 43.93 | 44.86 | 6.86 | 7.12 | 19.26 | 20.08 |
| | **A1** | 3.60 | 3.89 | 0.88 | 0.89 | 33.62 | 34.00 | 86.58 | 87.55 | 6.83 | 7.13 | 44.38 | 45.12 | 6.68 | 7.00 | 18.25 | 19.55 |
| 96 | **Cont.** | 3.96 | 4.01 | 0.95 | 0.97 | 35.53 | 35.88 | 87.00 | 87.26 | 5.70 | 6.55 | 46.63 | 46.78 | 6.71 | 7.12 | 19.00 | 20.03 |
| | **a** | 3.88 | 3.99 | 0.90 | 0.92 | 34.75 | 34.98 | 86.35 | 87.25 | 6.91 | 7.10 | 44.66 | 45.12 | 6.66 | 7.13 | 19.00 | 20.17 |
| | **A1** | 3.41 | 3.66 | 0.90 | 0.93 | 34.78 | 34.91 | 86.58 | 87.56 | 6.30 | 7.22 | 46.01 | 46.23 | 6.55 | 7.00 | 17.85 | 18.16 |
| 94 | **Cont.** | 4.16 | 4.28 | 1.00 | 1.00 | 34.11 | 34.33 | 87.01 | 87.23 | 6.50 | 7.14 | 43.68 | 44.25 | 7.51 | 7.65 | 19.00 | 19.85 |
| | **a** | 3.76 | 3.27 | 0.90 | 0.91 | 33.70 | 33.84 | 86.60 | 88.02 | 7.13 | 7.11 | 42.76 | 43.12 | 7.11 | 7.23 | 19.16 | 19.85 |
| | **A1** | 3.73 | 3.87 | 0.88 | 0.89 | 33.06 | 33.56 | 86.58 | 87.56 | 7.20 | 7.30 | 42.41 | 43.16 | 6.71 | 7.10 | 18.10 | 19.15 |
| Lsd | **A×B** | NS | NS | 0.08 | 0.11 | NS | NS | NS | NS | NS | NS | 0.13 | NS | NS | NS | NS | NS |
| Lsd | **A×C** | NS | NS | NS | 0.14 | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| Lsd | **B×C** | 0.09 | 0.09 | 0.09 | 0.14 | NS | NS | NS | NS | 0.13 | 0.16 | 0.16 | 0.18 | 0.13 | 0.18 | NS | NS |

**Table13:** Effect of the second order interaction between Location, varieties, and Dustable Powder on fiber characters as estimated by (HVI) during 2020 and 2021.

| | | | MIC | | Mat. | | Length. | | Unif. | | SFI | | STRength | | Elong | | Oil | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 | 2020 | 2021 |
| Ghrbea | 96 | **Con.** | 3.93 | 4.10 | 0.90 | 0.93 | 35.46 | 35.98 | 86.96 | 87.23 | 5.66 | 6.56 | 46.66 | 47.00 | 6.70 | 7.14 | 18.90 | 19.89 |
| | | **L1** | 3.86 | 4.00 | 0.90 | 0.92 | 34.76 | 34.78 | 86.20 | 87.02 | 7.03 | 7.02 | 44.33 | 45.12 | 6.73 | 7.00 | 18.90 | 19.85 |
| | | **L2** | 3.36 | 3.85 | 0.90 | 0.93 | 34.80 | 34.86 | 86.56 | 87.14 | 6.16 | 6.61 | 46.26 | 46.89 | 6.56 | 7.23 | 17.70 | 18.25 |
| | 94 | **Con.** | 4.16 | 4.22 | 1.00 | 1.00 | 34.10 | 34.50 | 86.90 | 86.93 | 6.43 | 6.52 | 43.50 | 44.02 | 7.40 | 7.85 | 18.90 | 19.00 |
| | | **a** | 3.80 | 3.98 | 0.90 | 0.92 | 33.70 | 34.00 | 86.66 | 87.56 | 7.03 | 7.09 | 42.66 | 43.16 | 7.10 | 7.12 | 18.90 | 19.08 |
| | | **b** | 3.73 | 3.86 | 0.90 | 0.93 | 32.90 | 33.23 | 86.60 | 87.14 | 7.16 | 7.20 | 41.83 | 42.89 | 6.60 | 6.96 | 17.70 | 18.85 |
| Qalyubia | 96 | **Con.** | 4.00 | 4.20 | 1.00 | 1.00 | 35.60 | 35.89 | 87.03 | 87.33 | 5.73 | 6.23 | 46.60 | 46.95 | 6.73 | 6.84 | 19.10 | 20.14 |
| | | **L1** | 3.90 | 4.10 | 0.90 | 0.92 | 34.73 | 34.86 | 86.50 | 87.45 | 6.80 | 6.90 | 45.00 | 45.33 | 6.60 | 6.96 | 19.10 | 20.19 |
| | | **L2** | 3.46 | 3.55 | 0.90 | 0.93 | 34.76 | 34.95 | 86.60 | 86.75 | 6.43 | 7.21 | 45.76 | 46.23 | 6.53 | 6.87 | 18.00 | 19.14 |
| | 94 | **Con.** | 4.16 | 4.56 | 1.00 | 1.00 | 34.13 | 34.77 | 87.13 | 87.22 | 6.56 | 7.00 | 43.86 | 44.90 | 7.63 | 7.38 | 19.10 | 20.20 |
| | | **a** | 3.73 | 3.98 | 0.90 | 0.92 | 33.70 | 34.01 | 86.53 | 87.14 | 7.23 | 7.33 | 42.86 | 43.16 | 7.13 | 7.16 | 19.43 | 19.98 |
| | | **b** | 3.73 | 3.94 | 0.86 | 1.00 | 33.23 | 33.98 | 86.56 | 87.22 | 7.23 | 7.54 | 43.00 | 44.16 | 6.83 | 7.11 | 18.50 | 19.55 |
| LSD | | | NS | NS | NS | 0.19 | NS | NS | NS | NS | NS | NS | 0.23 | 0.25 | NS | NS | NS | NS |

## Cotton Yield:

Dustable powder formulations either employing one spray or two sprays, the F3 treatment produced the highest cotton crop yield as evaluated in Kentar/Fed Table (14). F3 yielded 7.80 and 10.00 Kentar/Fed after a single spray treatment, compared to 7.33 and 9.33 Kentar/Fed in the corresponding governorates of Qalyubia and Gharbia. Additionally, it provided 9.67 and 11.66 Kentar/Fed as opposed to 9.33 and 10.30 Kentar/Fed. In Qalyubia and Gharbia governorates respectively. Although F2 as a dustable powder formulation had a significantly stronger impact on the two pests under study in both governorates than did F3, the cotton yield from F3 treatment was higher than that from F2 treatment in both governorates.

**Table 14:** Effect of dustable powder formulations on the yield of the cotton crop on using one spray and two sprays in Gharbia and Qalyubia governorates

| Formulation | Yield of cotton production (Kentar/Fed.) | | | |
|---|---|---|---|---|
| | 1st spray | | 2nd spray | |
| | Qalubia | Gharbia | Qalubia | Gharbia |
| **F2** | $7.33^{c}$ | $9.33^{c}$ | $9.33^{b}$ | $10.30^{a}$ |
| **F3** | $7.80^{e}$ | $10.00^{bc}$ | $9.67^{d}$ | $11.66^{b}$ |
| **Con.** | $5.67^{f}$ | $7.33^{b}$ | $6.00^{ef}$ | $7.45^{d}$ |
| LSD | 0.80 | 1.09 | 0.69 | 0.52 |

## Conflict of Interest:

The authors declare that they have no conflict of interest.

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## ARABIC SUMMARY

**دراسة تأثير مشتقات الكرومين المخلقه والمجهزه علي صورة مساحيق تعفير علي ديدان اللوز القرنفليه والشوكيه وتأثيرها علي انتاجية القطن وخواص النسيج تحت ظروف الحقل**

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تم تجريب مشتقات الكرومين المخلقه والمجهزه علي صورة مساحيق تعفير علي الطور اليرقي الثاني والرابع لدودة ورق القطن مسبقاً. ووجد أن لها فاعلية جيده. كان الهدف الرئيسي من هذه الدراسه هو تقييم فاعلية اثنين من مشتقات الكرومين المخلقه والمجهزه مسبقا علي صورة مساحيق تعفير، (F2 ) بتركيز 9.5٪ و (F3) بتركيز 10٪ علي ديدان اللوز القرنفليه والشوكيه تحت الظروف الحقليه في موقعين مختلفين بمحافظتين مختلفتين ، محطة مركز البحوث الزراعية "قها" بمحافظة القليوبيه و "المحلة الكبرى" بمحافظة الغربيه خلال موسمي 2021/2020 و 2022/2021. خلال مواسم الدراسه تم استخدام طريقتين مختلفتين للرش، رشه واحده ورشتين على الأفاتين محل الدراسه كما درست أيضا انتاجية محصول القطن وخواص الألياف. أظهرمسحوق التعفير (F2) فاعلية بيولوجية اعلي على الأفاتين محل الدراسه من مسحوق التعفير (F3) بطريقتي الرش المستخدمتين. خلال موسمي الدراسة، اتضح ان استخدام الرشه الواحده على الأفات محل الدراسه كان أعلي تأثيرا من استخدام الرشتين. بالإضافة إلى ذلك، كان مسحوق التعفير (F2) اعلي فاعلية على دودة اللوز القرنفلية منه على دودة اللوز الشوكية في كلا المحافظتين التي تمت بهم الدراسه. وعلى الرغم من أن الإنتاجية المتحصل عليها بإستخدام مسحوق التعفير (F3) كان أعلى بكثير من الناتج باستخدام مسحوق التعفير (F2) ، إلا أن محصول القطن وخصائص الألياف كانت أيضًا أفضل بكثير من الكنترول. بعد استكمال الدراسات اللازمه ، قد يتم استخدام مساحيق التعفير لمركبات الكرومين المخلقه للتحكم في دودة اللوز القرنفلية والشوكية في المستقبل.