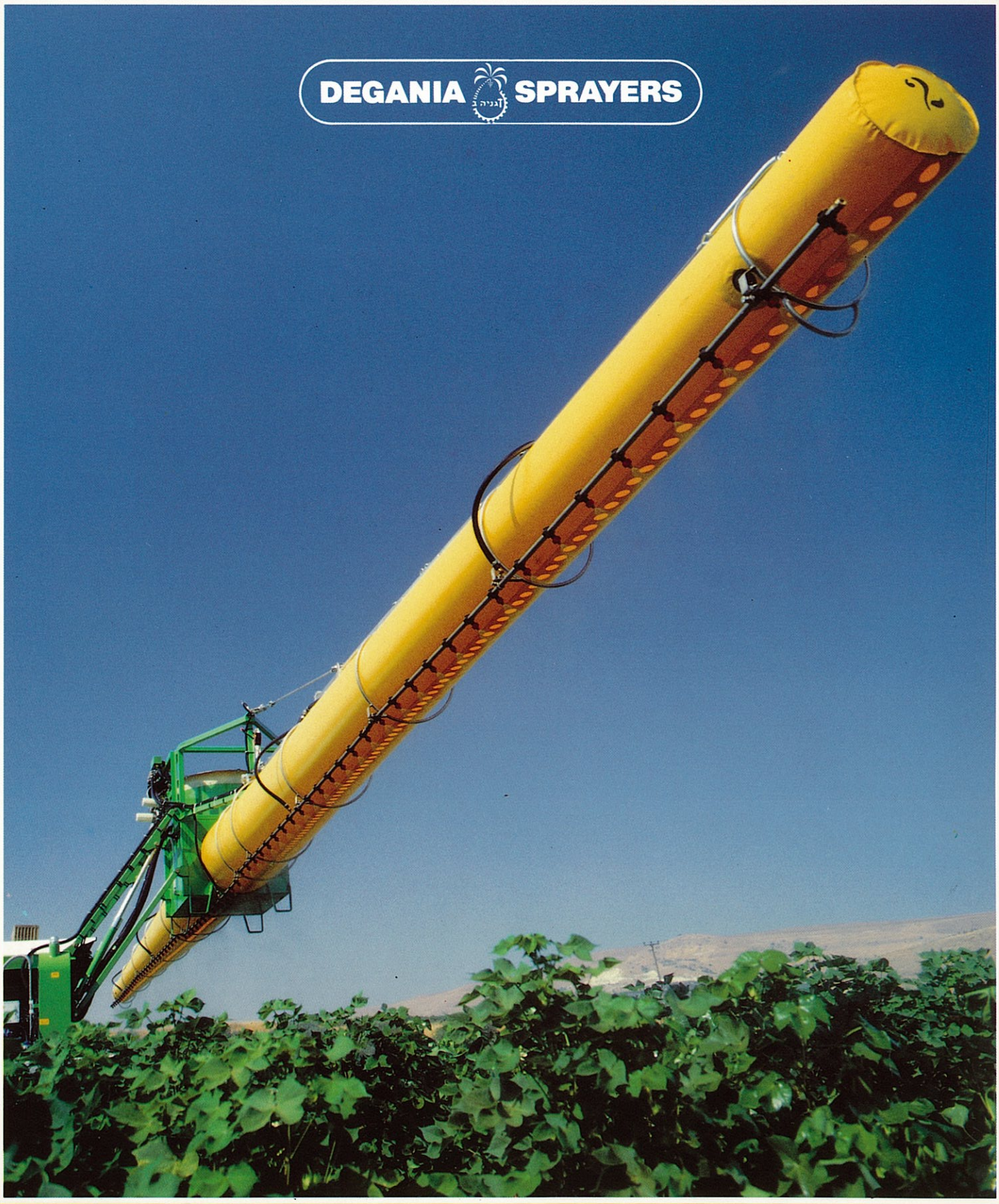
THE SLEEVE BOOM



BEST RESULTS FROM THE FIELD

DEAR FARMER

This brochure describes experiments carried out during the past ten years, since the Degania Sprayers Company, in Israel, developed the AIR ASSISTED SLEEVE BOOM method of crop spraying. Most of the experiments mentioned in this brochure were carried out in Israel, by research institutions affiliated to the Israel Ministry of Agriculture. The results were also evaluated in English research institutions, universities, as well as a manufacturer of pest control materials.

It is evident that no two agricultural regions are alike and that research and experiments conducted in the North of England do not resemble those performed in Israel. On the other hand, and with all due caution, the results that are presented in this brochure clearly point out the advantages of spraying with the SLEEVE BOOM as compared to spraying by conventional methods.

In view of the clear-cut advantages achieved by spraying with the SLEEVE BOOM, and in terms of experiments conducted during the past ten years, we can say that in other parts of the world, spraying with the SLEEVE BOOM yields improved agricultural, economic and environmental results.

The development of the sleeve boom resulted from an attempt to solve the following issues:

1. To increase the penetration of the spray material into spray crops.
2. To increase the coverage of the leaf - on both sides.
3. To reduce the number of applications required.
4. To reduce spray drift.
5. To increase the available time for spraying (ie., to enable spraying - even in adverse, windy conditions).
6. To achieve smaller drops.
7. To eliminate the necessity of spraying with the boom at a constant height above the crop.

* AIR ASSISTED SLEEVE BOOM = SLEEVE BOOM

A COMPARISON OF SPRAYING METHODS

The following are regarded as conventional methods: Spraying from the ground without SLEEVE, and spraying from light planes - the liquid is sprinkled from the spraying nozzle and it reaches the soil, due to gravity. When spraying in low wind conditions, it can be assumed that the spray will land more or less on the area targeted and that, due to its weight, it will end up covering the top of the foliage to be treated.

If winds are blowing in the vicinity - (and strength of the wind does not make a difference here) - then, the spray released from the spraying nozzle will not reach its destination. (The problem of drift of spraying materials, which are in general poisonous and dangerous to human touch, is treated in a special paragraph devoted to drift).

We will consider here only the amount of spraying material that landed on the area we wished to spray, due to gravity; it is evident that, if we are talking about a tall crop with a thick foliage, most of the spray material will cover the top part of the plants and only a small percentage of it will reach, in decreasing amounts, the lower portions of those same plants. Moreover, when we consider the spray covering on the top part of the plant, the amount of material on the upper side of the leaves is much greater than that on their lower side. And as we look at the plants from top to bottom, we will detect ever growing differences between the spray cover of the upper and lower side of the leaves.

The fact is that most of the pests and disease agents of all kinds prefer high levels of shade and humidity which are precisely the conditions to be found on the lower parts of the plants and on the underside of the leaves. As a result, the taller and the leafier a plant is, the more difficult it is to cover it with spray materials and attack its pests and other disease agents.

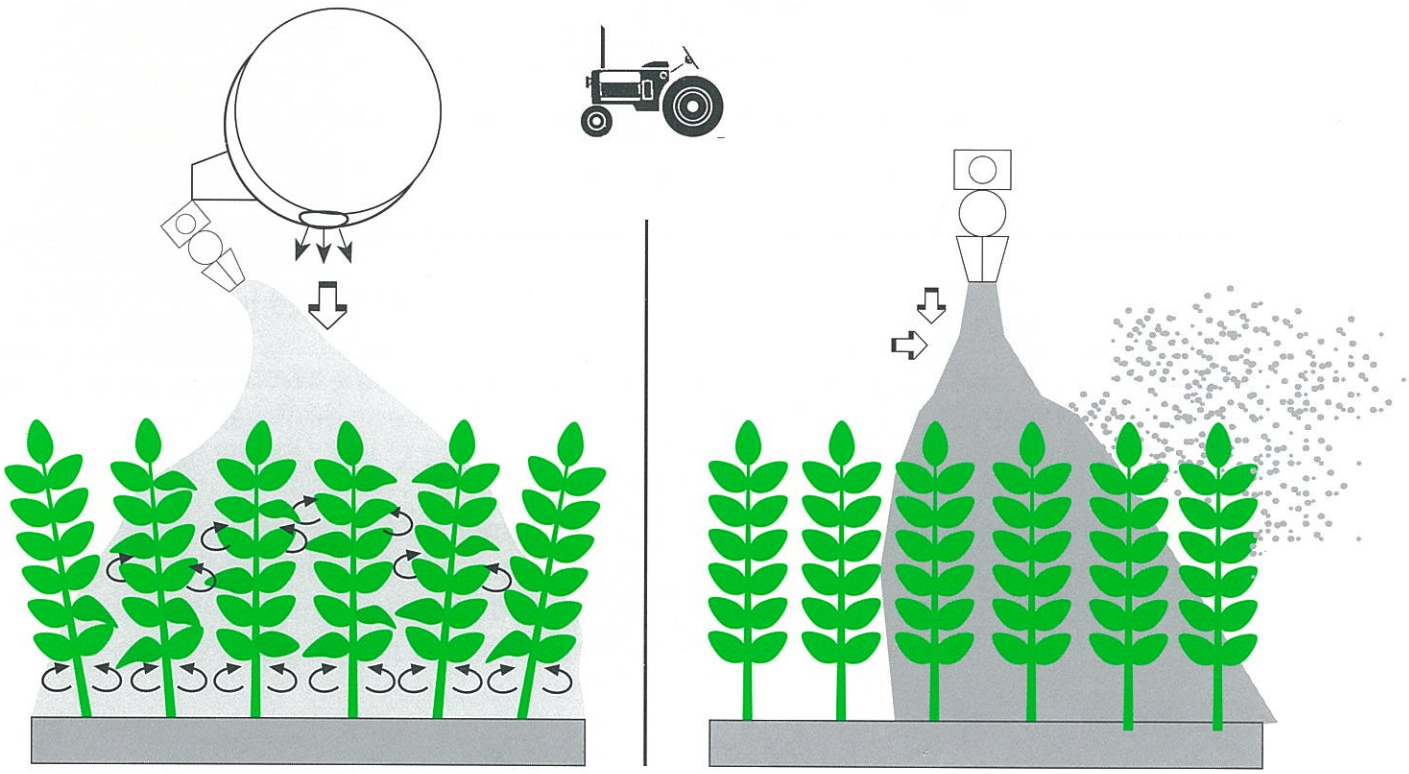
METHOD OF APPLICATION

The airflow coming out of the sleeve performs the two following functions simultaneously:

1. The leaves are shaken and turned so that their underside faces upwards occasionally.
2. The spray-bearing airflow can also reach the lower portions of the plants easily.

The SLEEVE brings about a major improvement in the spraying process by alleviating the drawbacks of the conventional sprayers: namely, those parts of the plant that could not be reached by conventional spraying (where most of the plant pests concentrate) received a much better covering, when sprayed with the SLEEVE BOOM.

In the diagram which follows, the differences between both methods of spraying are shown.



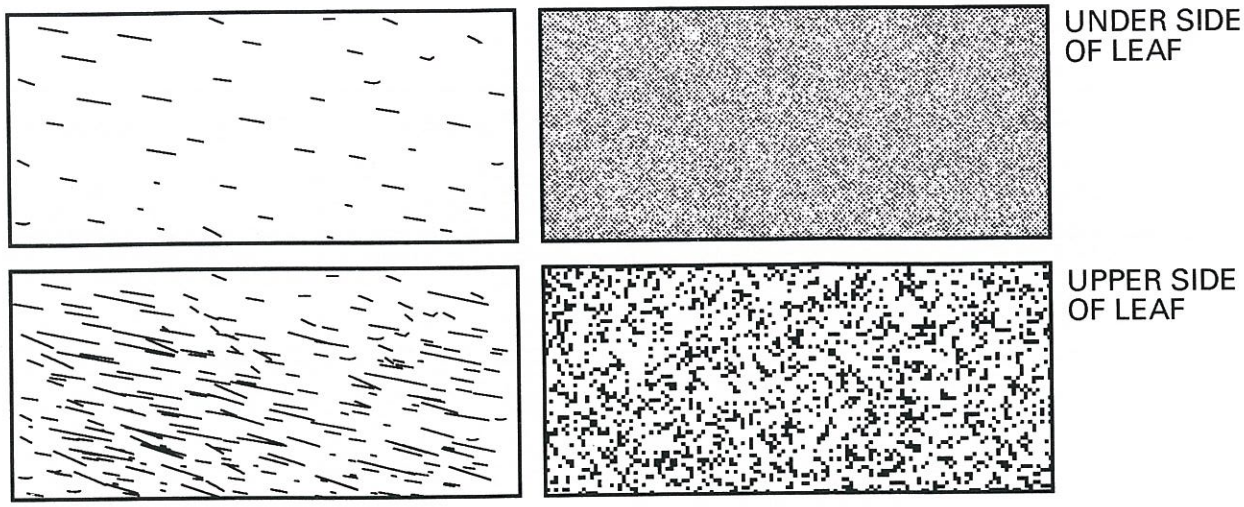
WITH AIR

WITHOUT AIR

The percentage covered, reflects a better penetration to the various regions of the vegetation and is also an expression of the density of the drops of spray.

A comparative test of spraying was carried out in England, utilising water sensitive paper, to evaluate the configuration and density of the covering. The results obtained follow:

CONVENTIONAL CLOSE SPACING AIR ASSISTED CLOSE SPACING

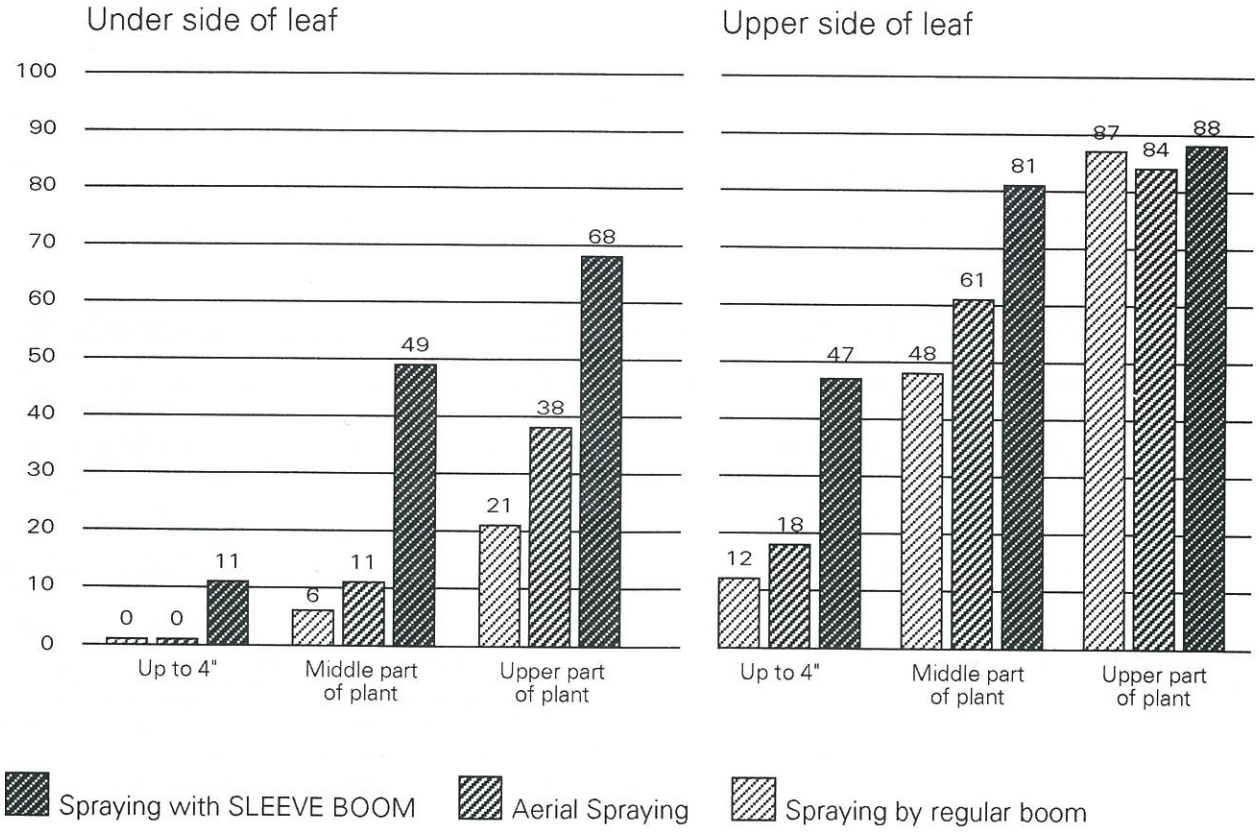


Neil Pavoley
Plant Pathologist
Kirton AO

The following experiments were conducted in Israel:

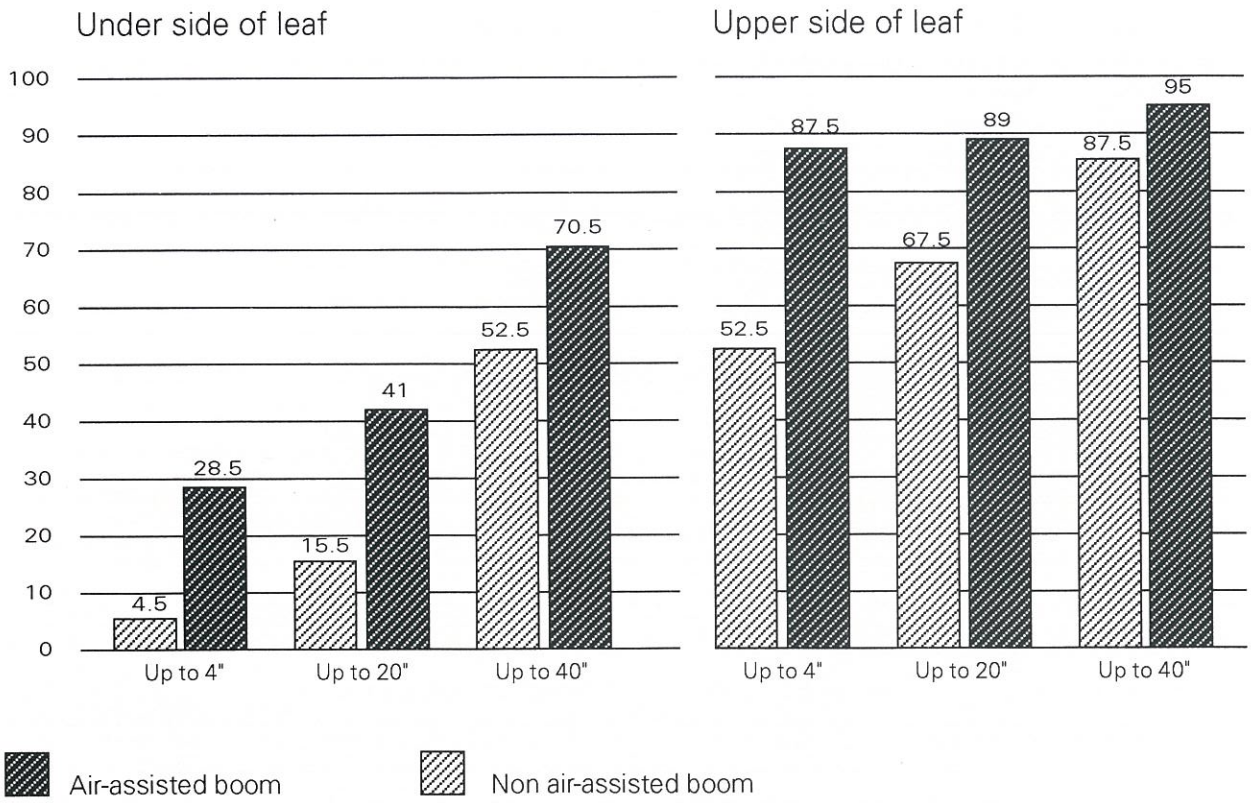
A comparison between spraying by SLEEVE BOOM and Conventional Spraying was made - in terms of the percent of coverage of cotton and peanuts crops achieved.

The two plants were not chosen arbitrarily. Both are good examples of the two ends of a spectrum of crops. Cotton is a tall plant with a rigid structure, while peanuts grow low, spread out on the ground, and are very pliable. These differences in structure are highly relevant when spraying by SLEEVE BOOM, in terms of wind and speed of travel.



Please PAY ATTENTION !!! The extent of the differences in the size of the areas covered is most significant when comparing those parts of the plants that are harder to reach, namely the middle and lower sections and the underside of the leaves.

Comparative Experiment on Coverage in a Crop of Peanuts



Again we wish to reiterate the results of the experiments shown in the Table:

The further down the plant section examined, the greater the difference of the percentage of coverage achieved - when spraying with the SLEEVE BOOM - as compared to conventional methods.

Many additional experiments were carried out in Israel and all showed the same significant differences in percentage of spray coverage.

The same kind of comparative experiments were carried out in England, at the department of agriculture science of the Bristol University. The results were almost the same.

AGRICULTURAL AND ECONOMIC ADVANTAGES

The greatly increased percentage of coverage achieved when spraying with the SLEEVE BOOM is not an end in itself. There are further advantages both in terms of Agriculture and Economy.

1. **To Harvest or not to Harvest**
   The method of spraying with the SLEEVE BOOM was often the only method available to eradicate a specific pest, resistant to conventional methods of spraying. In those instances, spraying with the SLEEVE BOOM made the entire difference between "TO BE or NOT TO BE". In cases like these, the difference moneywise is between a field whose crop can be sold and a field that goes to waste and whose crop is lost.

2. **Fewer Treatments are Required**
   In less extreme circumstances than those described above, spraying with the SLEEVE BOOM, as shown in the Tables above, gives a much better spray coverage than with a conventional boom, and it results in greatly enhanced pest control, meaning a higher degree of destruction of crop pests. One of the benefits of the improved pest eradication, is that those same creatures will take longer to reach the stage when another treatment of the same field becomes necessary. For example, cotton field sprayed by SLEEVE BOOM required only 11 treatments during the growing season, while an adjacent cotton field needed no less than 17 treatments when sprayed with conventional equipment. It means saving money.

3. **Less Spraying Materials are Needed**
   From the experiments described above we know for a fact that the farmer used identical spraying materials and that, for safety reasons, he used the same quantities per treatment. In economic terms, the difference between 11 and 17 treatments represents a difference of 36% in quantity of spraying materials required.

In pest-sensitive crops, such as cotton, tomatoes, etc., where a large number of sprayings is needed, a saving of 36% in pest control materials is indeed highly significant. The cost of spray materials constitutes an important factor in the total expenditure and is in large part responsible for the profit. This is why a substantial saving in quantity of spray required, can be translated immediately into **dollars and cents**.

The following Table represents the experiment described above; it shows the saving of 36% (including defoliations) in the amount of materials used.

Comparative Analysis of Aerial Spraying versus Spraying by SLEEVE BOOM on Akla variety.

Aerial Spraying			SLEEVE BOOM Spraying		
Number	Pest	Number of Days Since Previous Spraying	Number	Pest	Number of Days SInce Previous Spraying
1	Heliothis	–	1	Heliothis + Earias insulana Boisduval	–
2	Heliothis	14	2	Heliothis	14
3	Earias insulana Boisduval	9	3	Bemisia tabaci Gennadius + Heliothis	10
4	Bemisia tabaci Gennadius	11	4	Bemisia tabaci Gennadius + Heliothis	15
5	Bemisia tabaci Gennadius	9	5	Bemisia tabaci Gennadius + Heliothis	12
6	Bemisia tabaci Gennadius	10	6	Heliothis	7
7	Heliothis + Bemisia tabaci Gennadius	6	7	Bemisia tabaci Gennadius	4
8	Bemisia tabaci Gennadius	5	8	Bemisia tabaci Gennadius	10
9	Heliothis + Bemisia tabaci Gennadius	5	9	Bemisia tabaci Gennadius	11
10	Bemisia tabaci Gennadius	7			
11	Bemisia tabaci Gennadius	5		2 defoliations	
12	Bemisia tabaci Gennadius	4			
13	Bemisia tabaci Gennadius	5			
14	Bemisia tabaci Gennadius	5			
	3 defoliations				
		6.8 days average interval between treatments		10.4 days average interval between treatments	

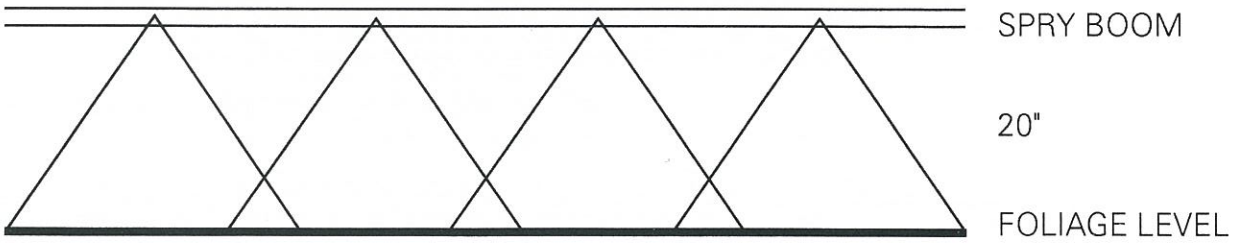
This Table shows the saving obtained by the need for a smaller number of treatments during the growth period of the crop. Here is an example of a conservative farmer who did not choose to reduce the amount of active materials per acre, but preferred to economize the number of treatments needed.

Today, following a large number of years of cumulative experiments, we know that it is possible, to reduce the amounts of active material per acre and still achieve improved pest control when treatment is by SLEEVE BOOM, rather than by conventional boom. From accumulated experience we know this to be true, also when spraying herbicides.

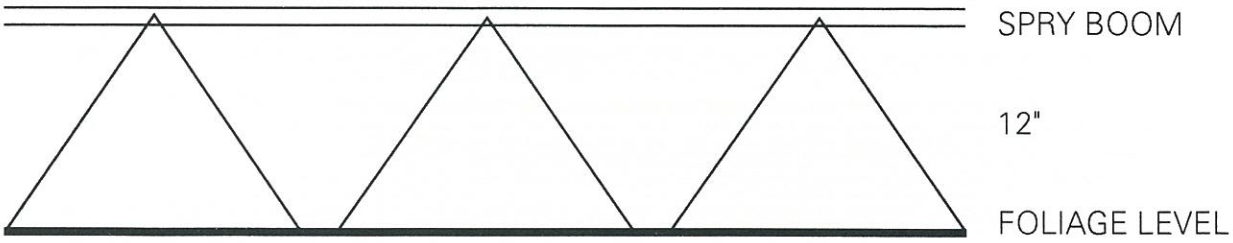
RECOMMENDATIONS FOR VARIOUS TYPES OF APPLICATIONS
HEIGHT OF SPRAYING

With conventional equipment it is recommended to spray 20" above the plant foliage which is an important recommendation, since this height provides for adequate overlapping of the sprinkling by the nozzles, which are 20" apart on the spray boom.

If we spray from a distance less than 20" above plants' foliage, overlapping will not be obtained and intervening strips of land will not be sprayed, giving a good chance for the pests on the untreated strips to spread and invade the areas which were sprayed and are thus pest-free after the treatment.



Example of overlapping providing optimal coverage



Example of spraying at a hight below the recommended height: there is no overlapping between the areas covered by the nozzles; as a result pest control is inefficient in those areas that did not receive the spray.

When spraying with the SLEEVE BOOM, the importance of height of spraying above the foliage is much less critical. With the SLEEVE BOOM, due to the airflow, a uniform screen of droplets is deposited over the entire length of the spraying path and the question of overlapping of areas covered by the nozzles along the boom - does not come into consideration.

Notwithstanding the above and on the basis of accumulated experience and evaluations conducted, it is clear to us that the optimal height for spraying with the SLEEVE BOOM is 40". This gives better coverage than spraying with the same SLEEVE BOOM from a height of approx. 25" above the top of the plants.

In order to explain this phenomenon, we found that the air turbulence is obtained at a distance of about 32" from the boom. In other words, at a distance of about 32" from the boom we obtain the same air currents that 'play' with the leaf, turning it so that sometimes its underside faces up and then receives the desired spray cover.

The following are the results of an experiment conducted to evaluate the percent of coverage achieved, when spraying with the SLEEVE BOOM from two different heights above the plants.

SPRAYING HEIGHT ABOVE GROWTH LEVEL

40"	20"	
25.00%	22.87%	Lowrer part of plant
4.00%	0.00%	
59.00%	50.62%	Middle part of plant
31.25%	14.50%	
88.12%	79.12%	Upper part of plant
84.50%	52.25%	
57.37%	50.87%	Top section average
39.91%	24.25%	Lower section average
48.64%	37.56%	Total average

EFFECT OF TRAVEL- SPEED DURING SPRAYING

Experiments carried out with peanuts, a soft plant having a flexible, weak structure, have shown that, contrary perhaps to simple logic, a greater speed of travel brings about better results when spraying is performed with the Sleeve Boom.

This phenomenon can be explained by the fact that, when the speed of travel is very low, due to weakness of the plant, the leaves get stuck together by the airflow, creating a protective screen that does not allow penetration of the spray, carried by the airflow, to the lower portions of the plant.

It is evident that this experiment characterizes a specific crop and its results may not necessarily be applicable in other cases. However, in the light of the many experiments that have been carried out to-date, it can be said that most crops can be sprayed within a range of travel speeds ranging from 3-6mile per h.

The following table presents the results of spraying at two different speeds of travel: Low and High. In order to add significance to the results, the experiment was repeated on three different farms, and for all three, the same results were obtained. The results show an improvement in coverage with the higher speed. This experiment was carried out on peanuts, a flexible, weak plant.

COVERAGE FOR TWO SPEEDS

Total Average	Average Lower Coverage	Average Top Coverage	Speed mile/h (approx.)
48.93	38.70	59.16	4.5 m
42.56	28.12	57	3 m
41.37	41.16	41.58	3.75 m
25.72	16.62	32.83	2 m
48.64	39.91	57.37	4.3 m
30.25	20.33	40.20	2.2 m

DRIFT PROBLEMS

There are three aspects to the problem of spraying materials, which are both highly toxic and expensive.

The first aspect is economic. Conventional spraying as described at the beginning of this brochure, is characterized by the slow descent of the material sprayed due to gravity. With this mode of spraying, breezes blowing during the spraying procedure, carry the spray material away from the field that it was supposed to cover. In other words, part of the spraying material does not reach its destination and does not contribute to pest control. As a result, even though the correct amounts of material were indeed used in the spraying of a given area, pest control did not reach the expected level because the wind conditions were unfavorable at the time of treatment.

The second problem is the ecological issue. Governments and local authorities are acutely aware today, of the damage caused to the environment by the widespread use of wind-borne, toxic substances, and their noxious effect on plant and animal life in the vicinity of sprayed fields. Today, more than ever, awareness of these dangers has brought about the imposition of restrictions by governments, dedicated to minimizing the potential damage by poisonous materials.

The results of tests which we carried out are shown in the following Table. It can be seen that using the SLEEVE BOOM significantly reduces the problem of drift.

The airflow which exits the SLEEVE BOOM at a speed of 120 f./sec is generally stronger than any ambient wind blowing above the field during spraying. With the assistance of ambient air currents, most of the material reaches the ground, and is dispersed among the plants that are being sprayed. The material is thus not carried away by the winds blowing in the area.

Comparative Results

Distance from the Boom	Sprayer with Conventional Boom (%)	Sprayer with SLEEVE BOOM Coverage (%)
0f.	100%	100%
30f.	100%	40%
60f.	100%	20%
90f.	–	12%
120f	100%	7%
150f.	–	5%
180f.	75%	2%
210f.	–	single drops
240f.	–	–
270f.	50%	–
300f.	50%	0
360f.	–	0
420f.	single drops	0
480f.	0	–
540f.	0	–
600f.	–	–

* Carried out by the extension service of Western Galilee.

The Table shows that with a regular spraying 'Single Drops' coverage appeared app. 420 f. away from the treated field. While with the SLEEVE BOOM, 'Single Drops' appeared already app. 210 f. from the sprayed point.

There is no doubt that ecological problems related to drift will increase in significance in the future: In this field too, the SLEEVE BOOM has a significant advantage. In terms of spraying under turbulent air conditions, the SLEEVE BOOM scores again when the issue of drift is under consideration.

The third adventage of using the SLEEVE BOOM sprayer is the increased time availble for spraying. Conventional spraying must be interrupted when winds become too strong and too much of the spray material is dispersed beyond the boundaries of the field to be treated.

The problem is that the pests do not take winds into consideration. Delaying spraying by one or more days - due to wind conditions - could result in heavy damages from an agricultural point of view.

As emphasized previously, the problem of wind activity is considerably reduced when SLEEVE BOOM spraying is considered. This means that the damage caused by delays in spraying is very much reduced.

With the SLEEVE BOOM there are more available spraying hours. We know of especially windy regions where it is extremely difficult to find periods of time suitable for conventional spraying.

With the SLEEVE BOOM spraying can be carried out during most hours of the day.

RECOMMENDED AMOUNTS OF SPRAYING SOLUTIONS

It is difficult to give a single recommendation for all types of crops. On the basis of experience accumulated by hundreds of farmers who started using the SLEEVE BOOM, we can state that most of them reduced by 30% to 50% the volume of spraying solutions used, in comparison to volumes consumed by conventional sprayers.

Basically it can be said that increasing the volume of spraying liquids always improves coverage and this is true for each of the various treatment methods (same boom, same speed of movement, etc.).

However, it can also be stated that the improvement in coverage achieved by spraying with the help of airflow, allows a significant reduction in the volume of water used for dissolving the pesticides, while providing an improved level of coverage than that obtained by conventional spraying and larger volumes.

For example, in the past, vegetables in Israel were sprayed with volumes of solutions of 40 gallons per acre; today the same vegetables are sprayed with 15 gallons per acre.

Another example: In the past, cotton in Israel was sprayed with spraying liquids at 15 gallons per acre; today only 5 gallons per acre. are used.

Numerous and varied examples emphasize a saving of water reaching 30-40% as against spraying by conventional methods.

The decrease in the volume of water required to achieve efficient spraying cover of plants, yields yet another advantage: An increase in the efficiency of spraying per time unit.

A large portion of the spraying time is devoted to travelling to and from the water replenishing point. A careful estimate of that time amounts to 30% of spraying time. When spraying is performed with volumes of water reduced by 30-40%, the result is that 30-40% less time will be spent replenishing. In other words, the efficiency of spraying per unit of time will increase.

CONCLUSION

We did not attempt to cover all of the experiments that were carried out with the SLEEVE BOOM over the past 10 years. However our intention was to present the revolution which has taken place during this period of time, in the field of agricultural spraying.

We chose to end this brochure with quotations of what various farmers in Israel and in England had to say about our equipment.

Farmer: ... "I'll tell it to you straight: this machine is a revolution. It is a breakthrough in the field of spraying; today the farm gets full benefits from the spraying materials that are bought at such an expense. We never had it that way..."

Farmer: ... "You have in your hand something which is like "the latest" in the world of spraying. It is not on the same wavelength we know ..."

Farmer: ..."Melons, a very sensitive crop; with a regular boom, the crop held on until May; with the Sleeve Boom, we can delay picking for up to another month and a half and consequently we get a bigger yield..."

Machinery instructor: ..." This piece of equipment is capable of doing an outstanding job also on Corn. It is something we never thought of. It sprays corn 3-4 meters high with efficiency and there is no other machine capable of doing that, like the sleeve boom."

Machinery instructor: ... It turns out that the SLEEVE BOOM spreads out the stems without breaking them and the results are outstanding. We not only saved spraying materials but a complete crop".

Farmer: ..."This machine has advanced agriculture by 20 years"

Machinery instructor: ..."This equipment, when in the hands of farmers has a positive significance way beyond what is said about it and what we know about it...".