WeedOUT

INNOVATIVE BIOHERBICIDE SOLUTIONS

ניצול מערכת הרבייה הטבעית של העשבים בכדי למנוע את התפשטותם

ד"ר אורלי נויבירט-בריק

יולי 2021

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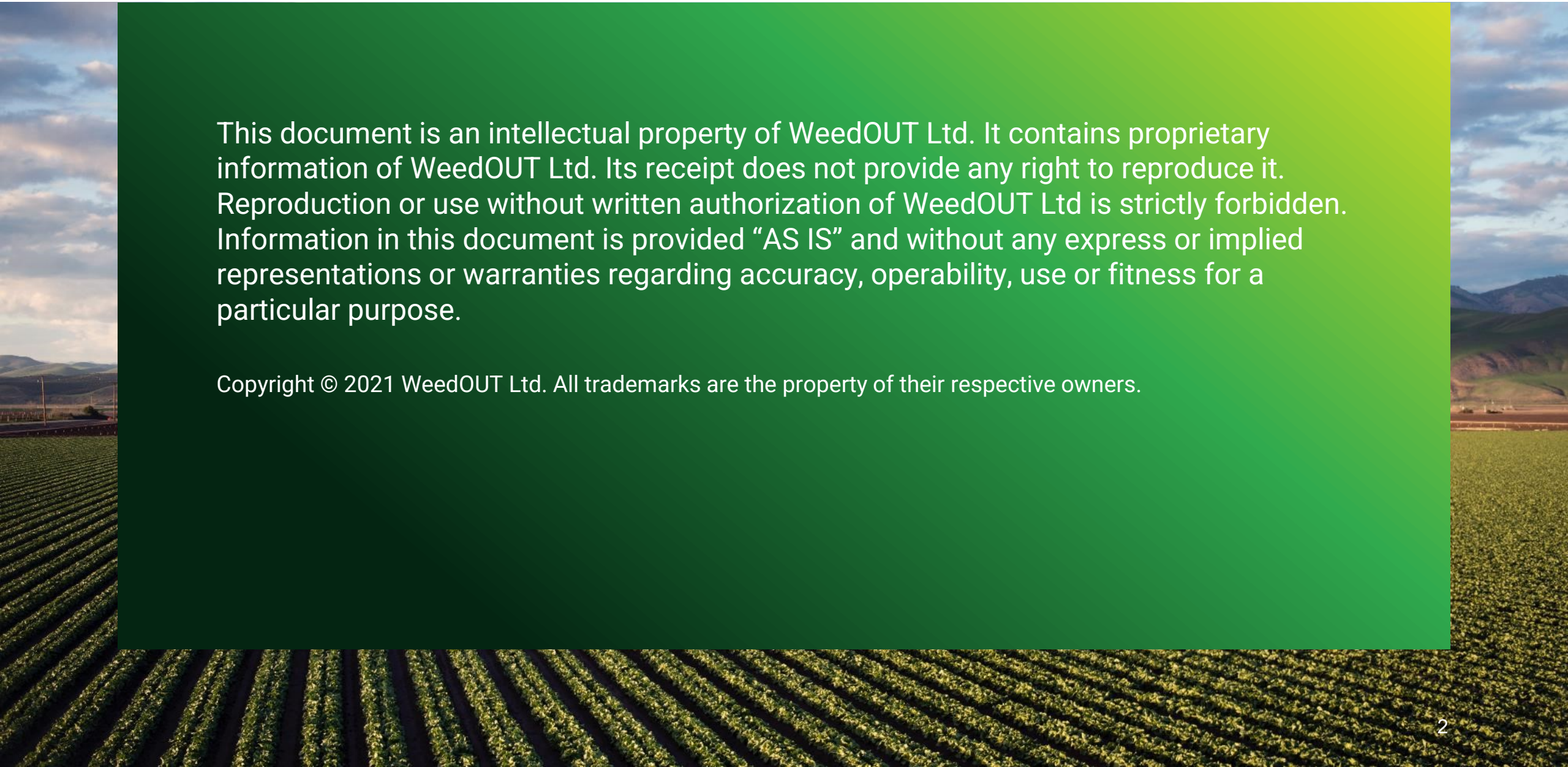

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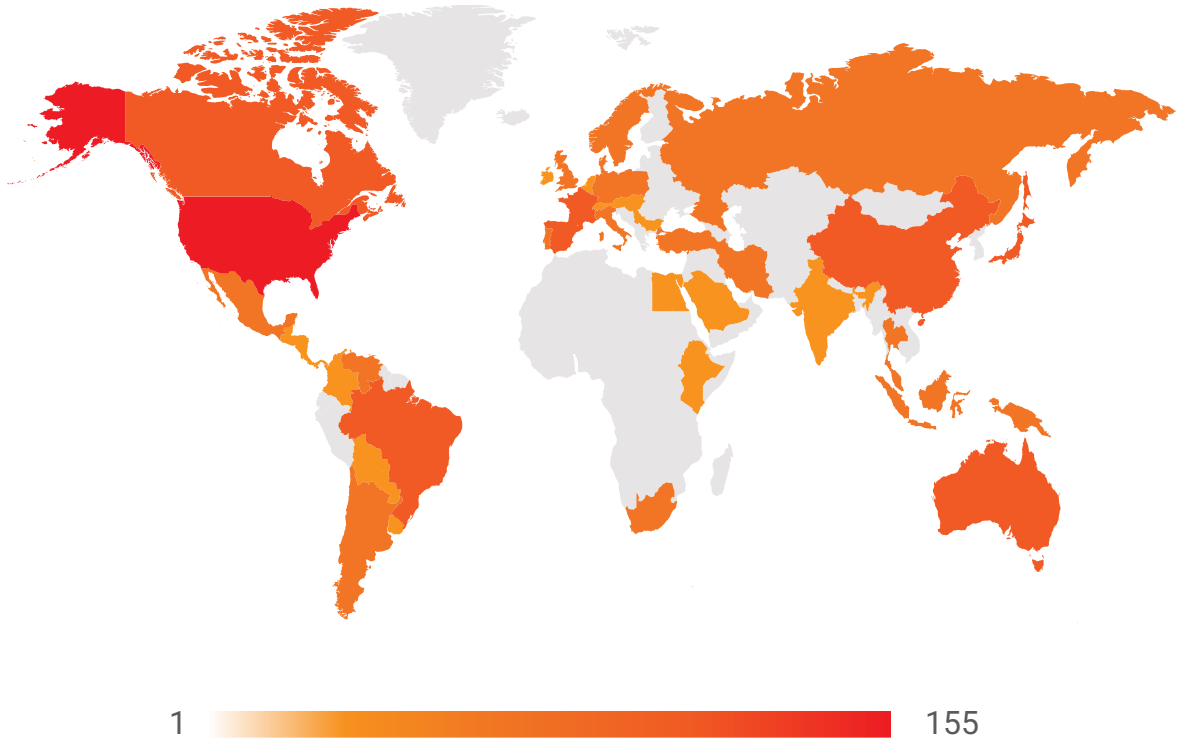
RESISTANT WEEDS - A SERIOUS THREAT TO CROPS

Number of unique herbicide resistance cases globally [1]



- Resistance against 23 out of 26 existing herbicides MOAs has been reported
- In the US over 65% of crop growers have herbicide resistance in their fields [2]

Drastic reduction in crop yield due to increased weed resistance endangers global food security

1. Heap, I. The International Survey of Herbicide Resistant Weeds, 2016 Unique herbicide resistance case = weed species that is resistant to a specific herbicide mechanism.
2. Weeds To Watch 2016: An Ever Growing Problem, 2016.

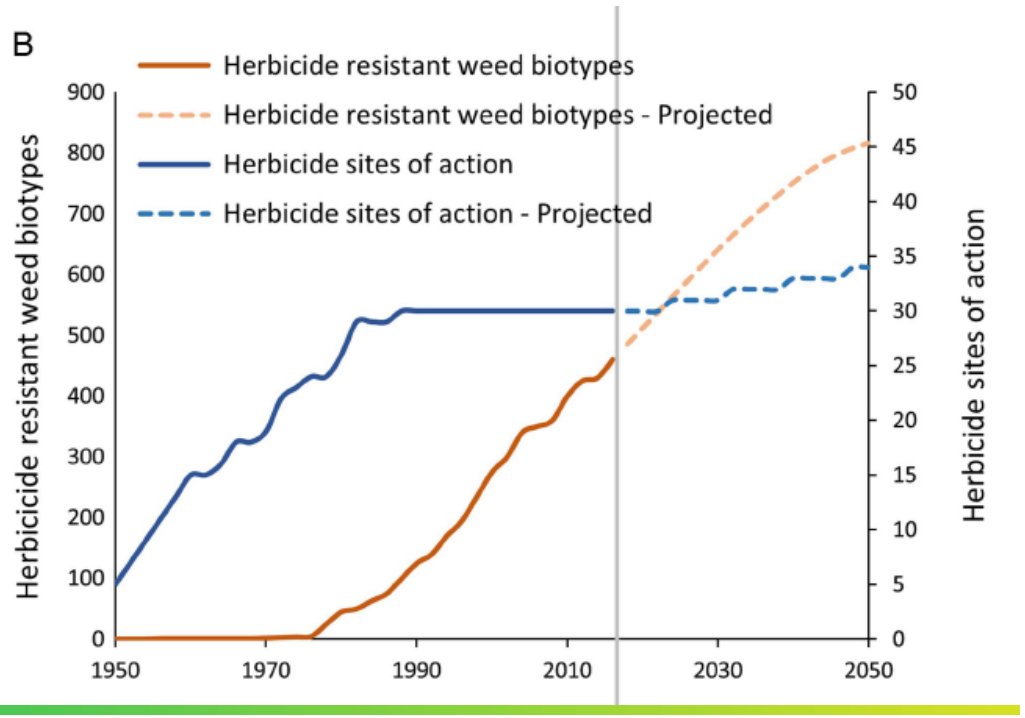
A GROWING NEED FOR NEW APPROACHES TO FIGHT WEEDS

Weed Management in 2050: Perspectives on the Future of Weed Science

James H. Westwood[1], Raghavan Charudattan[2], Stephen O. Duke[3], Steven A. Fennimore[4], Pam Marrone[5], David C. Slaughter[6], Clarence Swanton[7]

In general, new herbicides with old MOAs and new transgenic crops that are resistant to old herbicides (e.g., 2,4-D and dicamba) are only short-term solutions to some existing weed problems, because resistance already exists to these herbicides.

The future of chemical control depends on the discovery of herbicides with new MOAs,



"The idea is that using multiple different weed management tactics, rather than one big hammer of herbicide, such as cover crops, cultivation and just tweaking your production system to disadvantage weeds whenever possible, these can combine to have a big effect,"

https://www.goodfruit.com/new-approaches-needed-for-weed-control/

EXPLOITING STERILITY TO WIN BATTLE AGAINST RESISTANT WEEDS

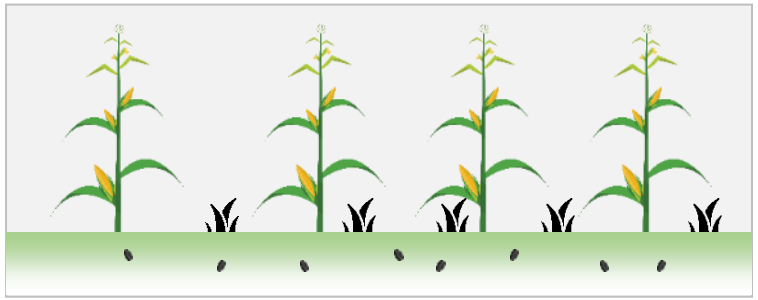
Spraying treated pollen to diminish resistant weed

Unique proprietary weed pollen:

- Efficiently fertilizes female ovule
- Leads to formation of aborted seeds

Industrial pollen harvesting from weed plants → **Pollen treatment** → **Field spraying of treated pollen** → **Blocking resistant weed spreading**

WEEDOUT'S TECHNOLOGY

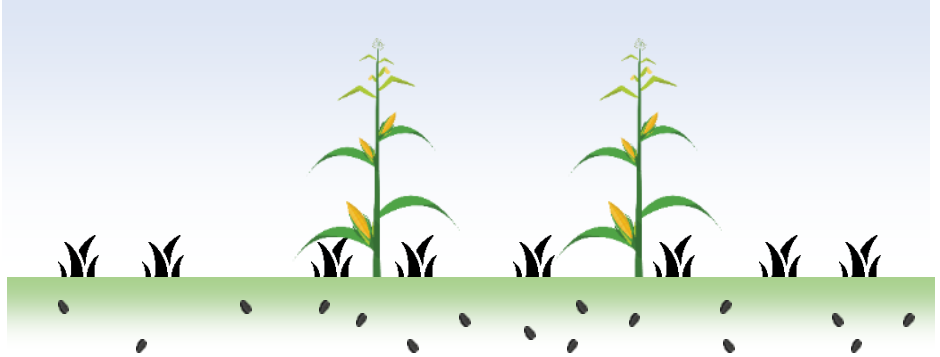


Crop

Resistant weed

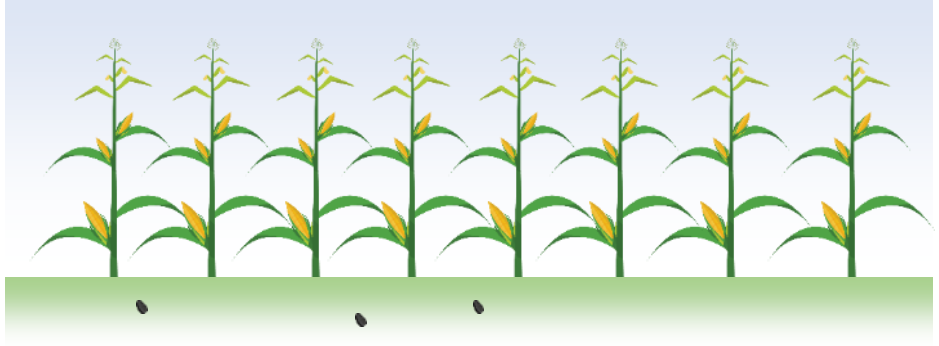
Resistant seed

NO TREATMENT



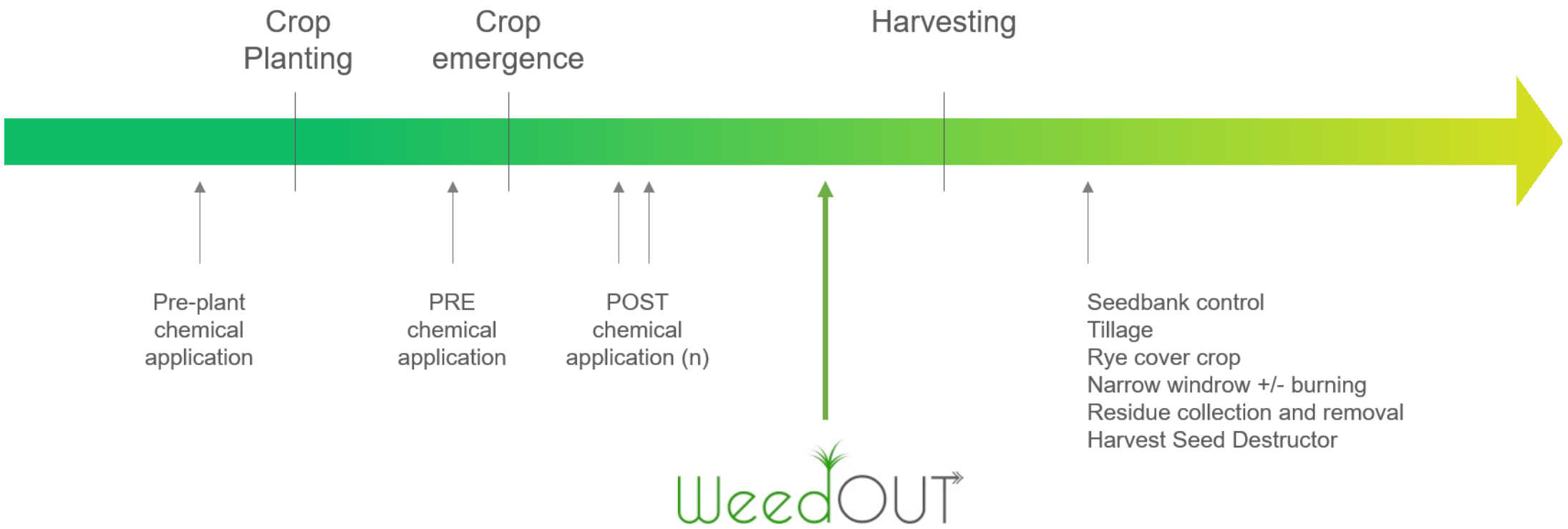
Population drift

WEEDOUT'S TREATMENT



Get evolution back on track
Significantly reduced weed seed bank and population

INTEGRATED WEED MANAGEMENT



WEEDOUT'S STATUS

1st product targeting A. palmeri demonstrated high efficacy in field trials

PoC achieved in another top problematic US weed - Waterhemp

Strong IP portfolio established

Founded in 2016, 10 employees

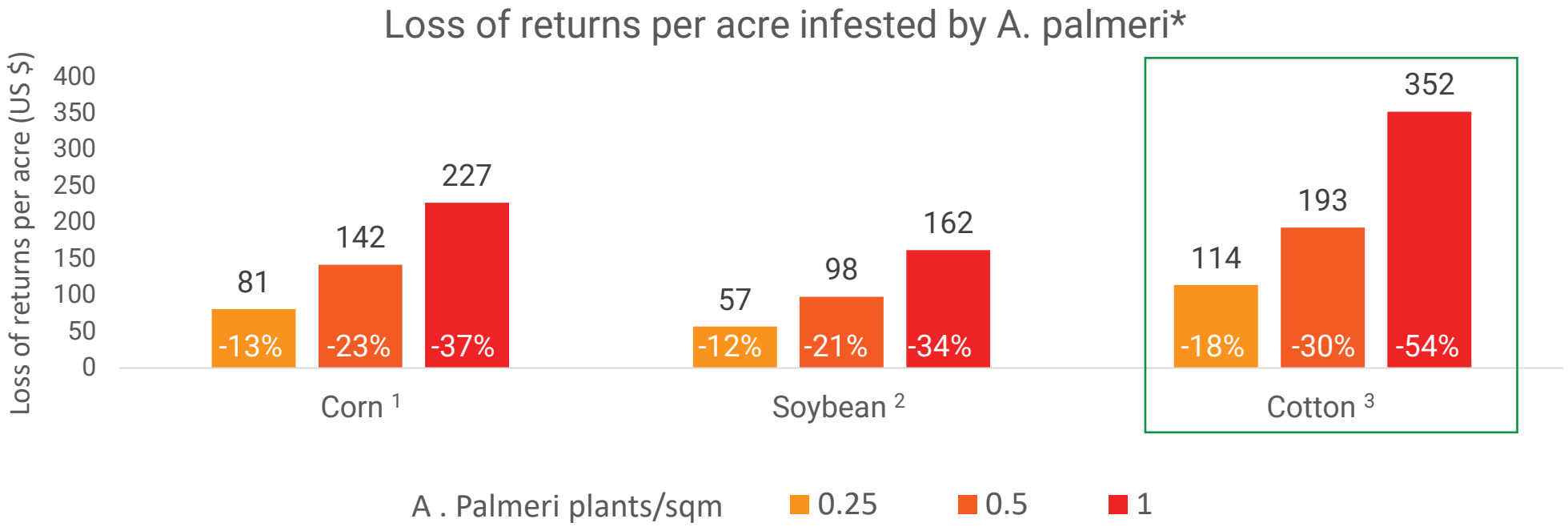
Main investors: Syngenta Ventures, CEIIF Ventures, Fulcrum Global Capital

WeedOUT was chosen as the Best Israeli Ag-tech Company in the Agrivest competition, 2018

WeedOUT won the Radicle Challenge Israel, 2019

WEEDOUT'S 1ST PRODUCT – TARGETING PALMER AMARANTH

HUGE LOSSES OF RETURNS DUE TO A. PALMERI INFESTATION



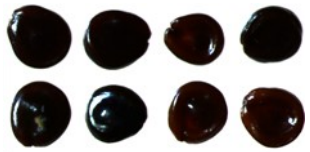
Furthermore, infested fields are at high risk of complete destruction due to resistant A. palmeri weeds

*Calculations based on USDA costs and returns (2016 – 2017) and yield loss according to: 1. Massinga et al., 2001, 2. Klingman et al., 1994, 3. Morgan et al., 2001

WEEDOUT'S 1ST PRODUCT – TARGETING PALMER AMARANTH

Breakthrough results in the battle against resistant weeds

SEED MORPHOLOGY



Control seeds

WeedOUT seeds

AVERAGE GERMINATION RATE

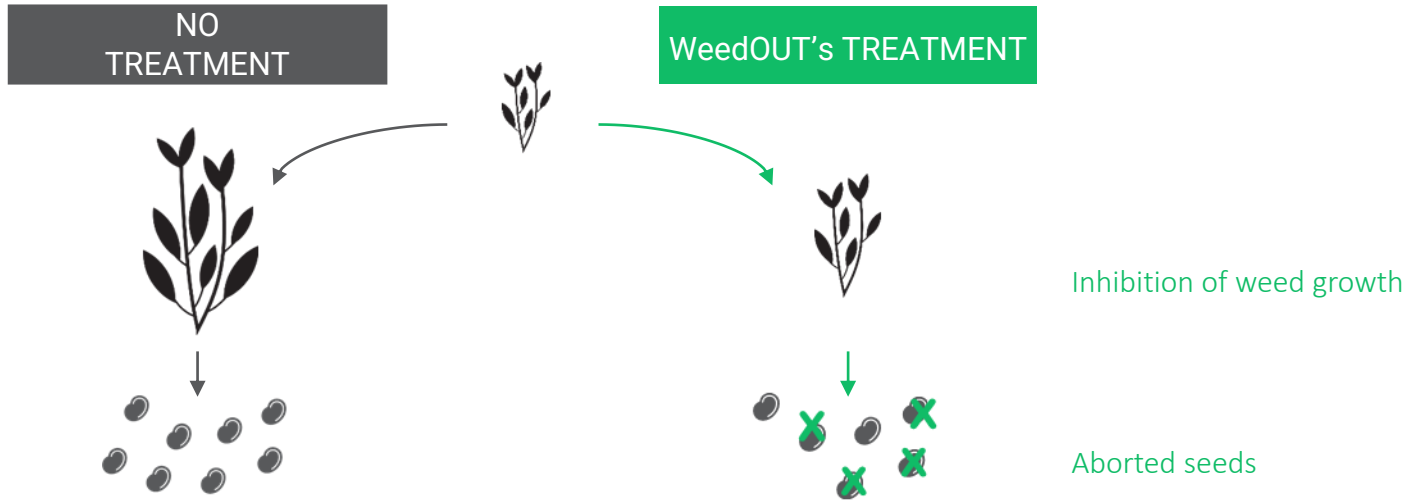
Control: **72%**

Treated: **0%**

P-value: **0.00002**

Seeds produced by WeedOUT's treated pollen cannot germinate

Inhibition of weed growth ← **Dual effect** of WeedOUT's treatment → **Seed abortion**



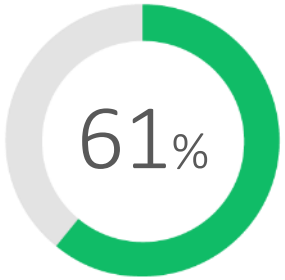
WEEDOUT'S EXPERIMENT SITES

Pollen manufacturing net house

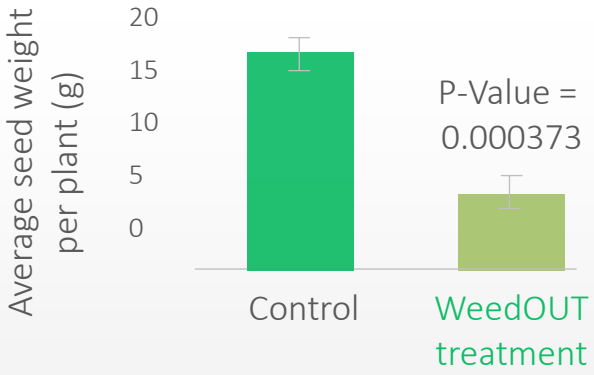
SMALL SCALE POLLEN PRODUCTION & APPLICATION PROCEDURE USED FOR FIELD TRIALS

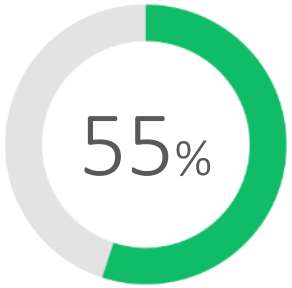
Manufacturing → Collection → Treatment → Application

FIELD TRIAL, SUMMER 2018 RESULTS – ISRAEL



Reduction in new formed seeds





Reduction in weed biomass

Application: Every 2 weeks

US FIELD TRIAL, 2019

Experiment is conducted in collaboration with Prof. Culpepper (Georgia University)

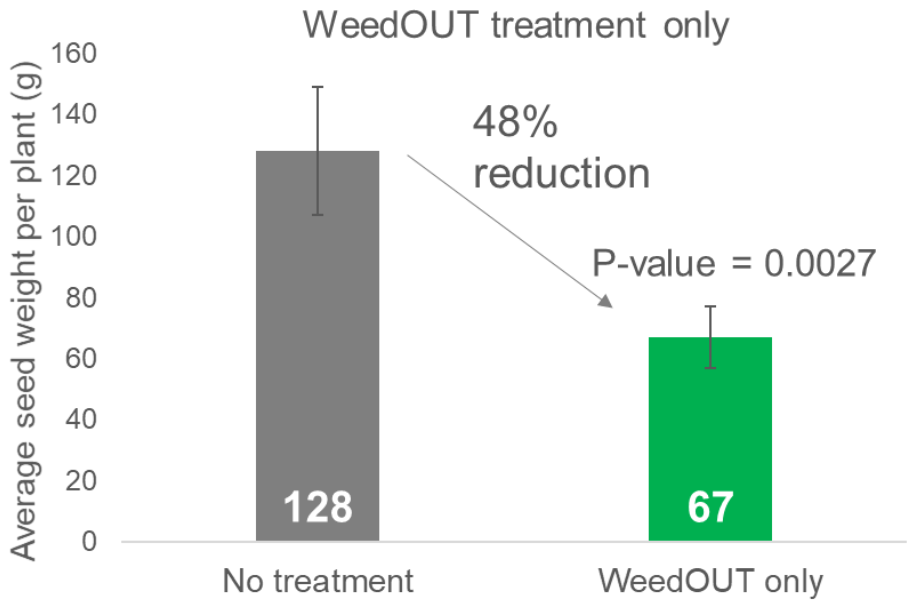
- Crop: Cotton
- Weed: A. Palmeri

- Several treatment regimens were tested alone and following Dicamba treatment at the beginning of the season

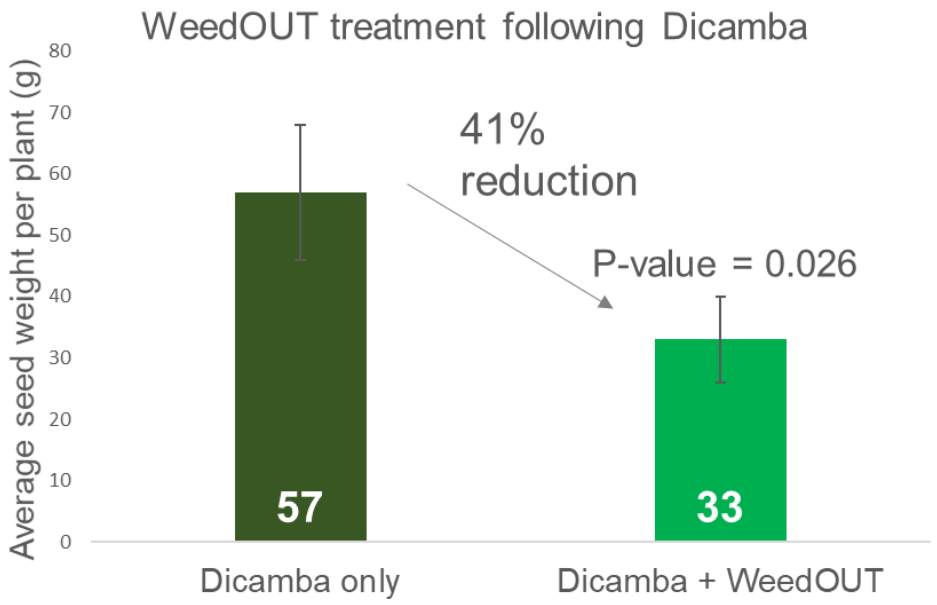
- The intention was to mimic Dicamba resistance scenario and thus Dicamba treatment was applied on seedlings bigger than standard (7-10”)

Most efficient regimens:

Reduction in average total seed weight following WeedOUT's treatment



Giant Palmer plants were obtained



More "real-world" situation

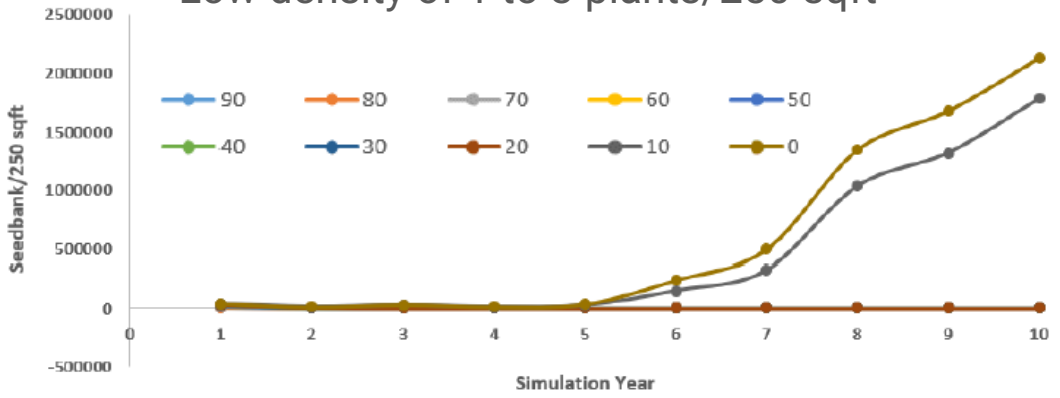
First demonstration of WeedOUT treatment as a part of an IWM approach

SIMULATION OF WEEDOUT TECHNOLOGY LONG-TERM EFFECT

Simulating the impact of the WeedOut Technology on the population dynamics of Palmer amaranth
By Prof. Muthukumar Bagavathiannan (Aug. 2019)

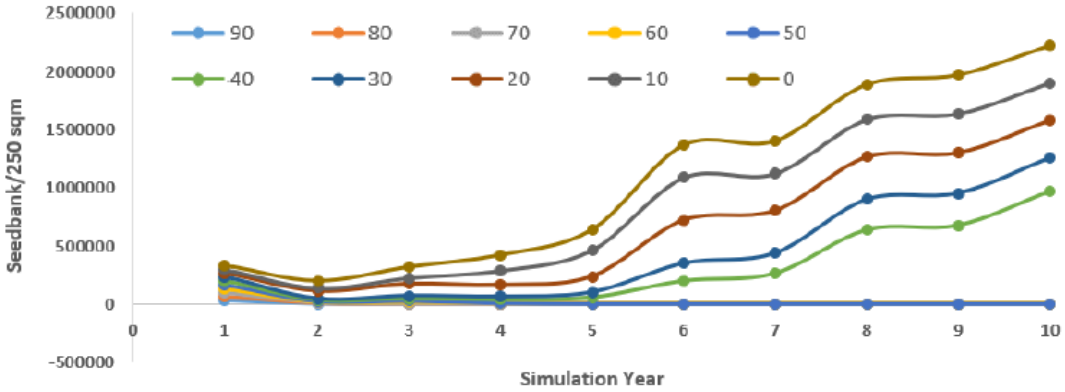
Cotton-soybean rotation: PPO-inhibitor & dicamba resistance

Low density of 1 to 3 plants/250 sqft



"Under resistance to both PPO-inhibitors and dicamba, the seedbank sizes continue to increase when WeedOUT is not included. However, inclusion of WeedOUT treatment with **efficacies >20%** dramatically reduces seedbank size."

Very high density of 16 to 25 plants/250 sqft



"In this scenario, seedbank sizes reach uncontrollable levels over time and application of WeedOUT at **efficacies >50%** are effective in reducing long-term seedbank densities."

WEEDOUT PRODUCT EFFICACY – ON-GOING IMPROVEMENT

- Treatment regimen optimization
- Formulation optimization

קיץ 2021 – שיתוף פעולה עם צבר קמה: פיילוט בשדה כותנה

- הפיילוט מבוצע בתימורים על שטח של כ-10 דונמים
- השדה מאולח בירבוז פלמרי ברמת צפיפות משתנה
- זו הפעם הראשונה שהטכנולוגיה תבחן בתנאי שדה אמיתיים כחלק מתוכנית ההדברה הכוללת
- בתום העונה צמחי הירבוז יקצרו והירידה בכמות הזרעים הרגילים תבחן כמדד ליעילות הטיפול

MARKET EXPANSION OPPORTUNITY

WeedOUT technology is highly applicable to the world's most problematic weeds[1]: (marked by ★).

CORN FARMING IN NORTH AMERICA

- ★ Palmer amaranth (Amaranthus palmeri)
- ★ Waterhemp (Amaranthus tuberculatus)
- ★ Kochia (Kochia scoparia)
- marestail (Conyza canadensis)
- ★ Ryegrass (Lolium spp.)
- Wild oat (Avena fatua)
- Johnson grass (Sorghum halepense)
- ★ Giant ragweed (Ambrosia trifida)
- Panicum species

CEREAL FARMING IN NORTHWEST EUROPE

- ★ Black grass
- Avena spp.
- ★ Alopecurus spp.
- ★ Lolium spp.

SOYBEAN FARMING IN LATIN AMERICA

- Digitaria Insularis
- Eleusine Indica
- ★ Lolium spp.
- Chloris spp. / Trichloris spp.
- Sorghum halepense
- Conyza spp.
- Euphorbia heterophylla
- Bidens spp.
- ★ Amaranthus spp.

In Australia, in major cropping areas, close to 100% of ryegrass (lolium rigidum) field samples have resistance to selective herbicides and most are resistant to multiple herbicide modes of action[2,3].

1 Most problematic weeds worldwide - Bayer | 2 Pannell et al., 2016 | 3 GRDC - Resistance rising across Australia

ACKNOWLEDGMENT

WEEDOUT'S SCIENTIFIC ADVISORS

Prof. Micheal Owen

Prof. Jonathan Gressel

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Prof. Stanley Culpepper

ISRAELI FIELD TRIAL COLLABORATIONS

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Dganim – Aya Raphael-Cohen

THANK YOU!