“eyeSpot” – leaf specific droplet applicator for weed control in field vegetables

Alistair Murdoch, Nikolaos Koukiasas & Paul de la Warr (Reading)

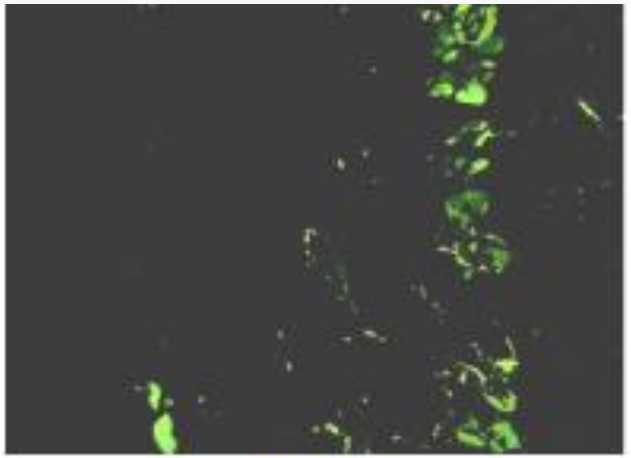
Robert A Pilgrim & Shane Sanford (USA)

Co-funders for UK activities:
AHDB-Horticulture (Project CP134), Douglas Bomford Trust (UK), University of Reading

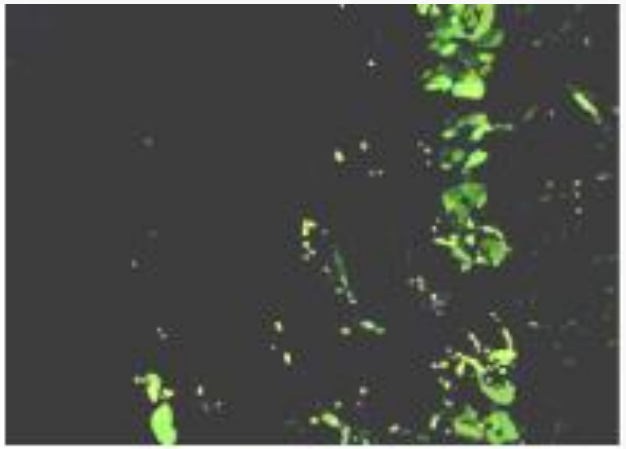
Machine Vision Tasks

Is an object a plant? Is it large enough to target?
Is it crop or a weed? If weed, is it safe to treat?
If yes, schedule for droplet application

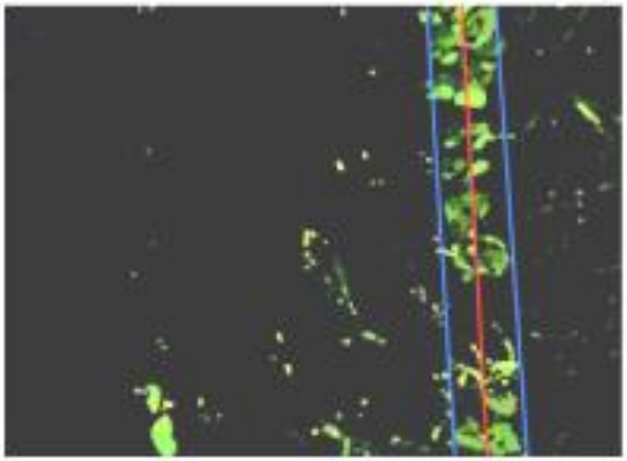
image capture



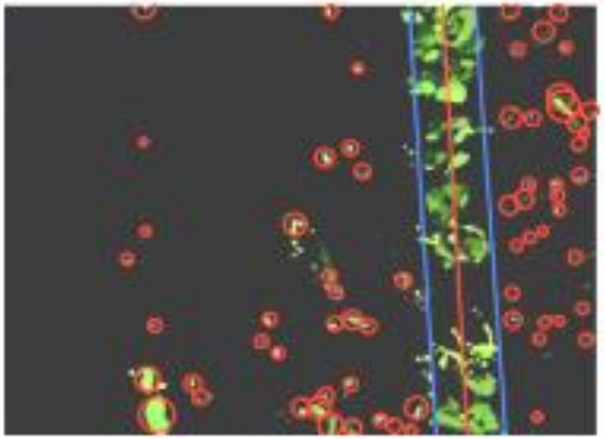
segmentation



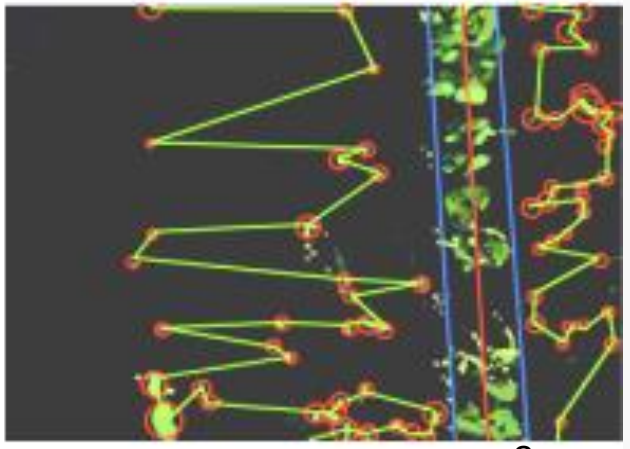
despeckle



seedline detection



plant centroids

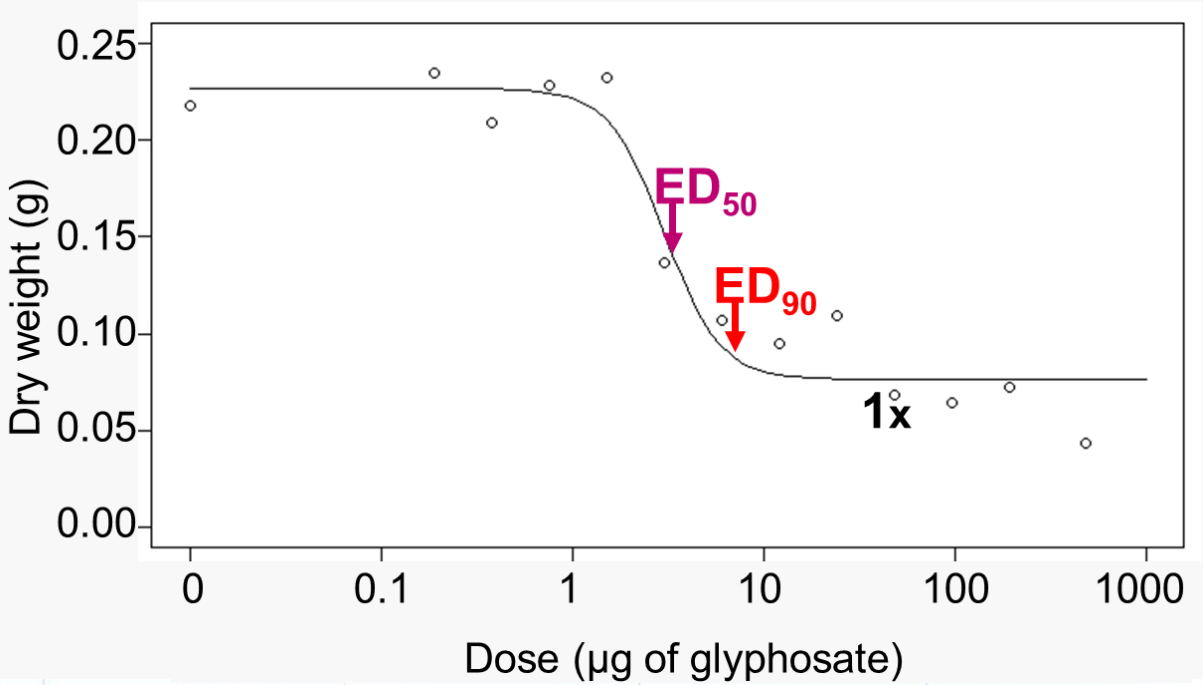


scheduling

Do droplets work?

University of Reading

Response of
Stellaria media seedlings
to dose of glyphosate



Control Adj 1/256 1/128 1/64 1/32 1/16 1/8 1/4 1/2 1x 2x 4x Gly

ED_{50} ED_{90}

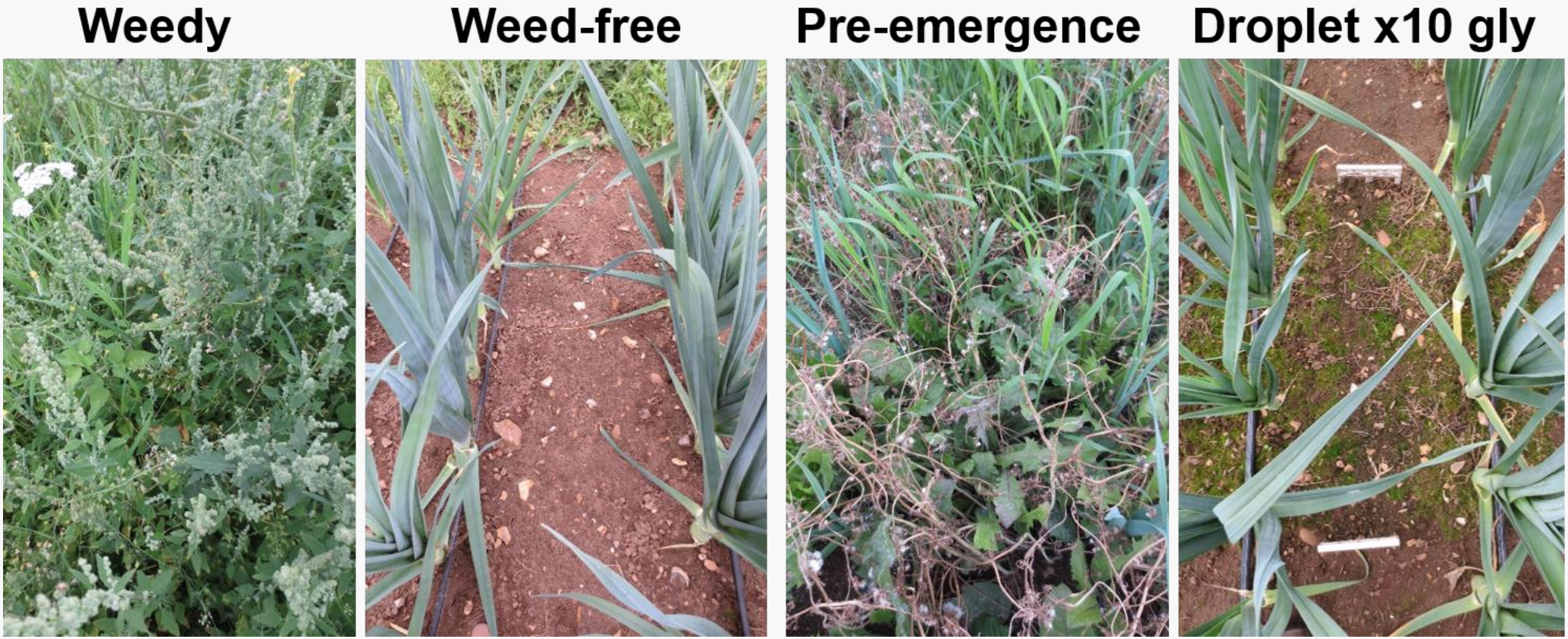
University of Reading

Some dose-response studies

Weed	1x (µg)	ED50 (µg) (±SE)	ED90 (µg) (±SE)
Glyphosate			
Stellaria media	48.8	3.04 (1.1)	6.3 (7.8)
Amaranthus retroflexus	419.8	13 (2.05)	46 (19)
Glufosinate-ammonium			
Amaranthus retroflexus	321.6	45.3 (21.4)	1683 (2145)
Chenopodium album	21.8	4.4 (1.2)	9 (6.1)
Urtica urens	28.1	1.4 (0.3)	3.4 (2.4)

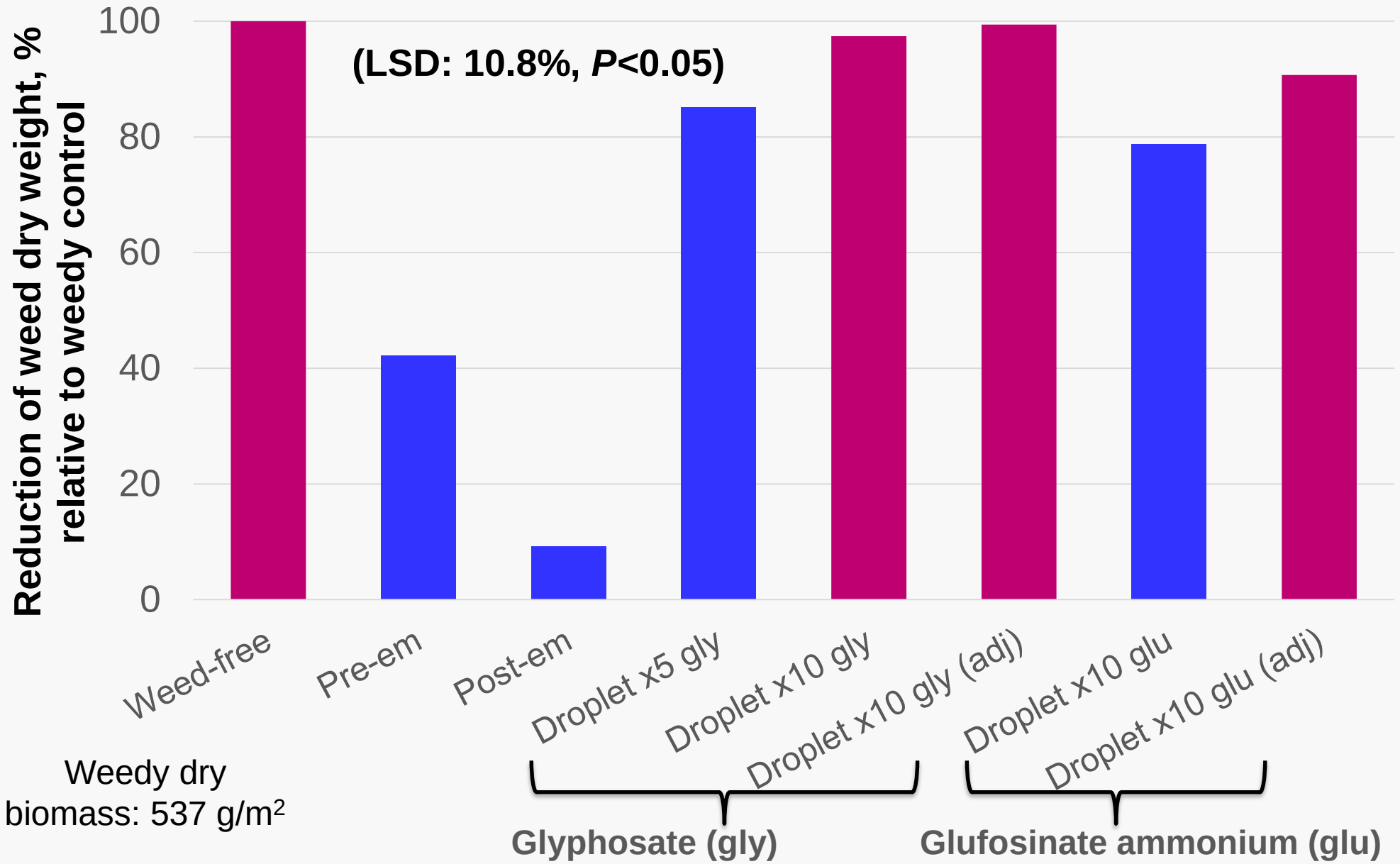
University of Reading

Leeks 2017
eleven weeks after transplanting



Droplet x10 gly: droplets of glyphosate were manually applied 10 times,
2, 4, 5, 6, 7, 8, 9, 10, 11 & 12 weeks after planting (last treatment 16 d before harvest)

Efficacy of weed control (leeks)



Weedy dry biomass: 537 g/m^2

Trimmed leek yield (2017)
100% = 42.2 t/ha

University of Reading

Yield relative to weed-free control, %

(LSD: 18.5%, *P<0.05*)

100
80
60
40
20
0

Weed-free
Weedy
Pre-em
Post-em
Droplet x5 gly
Droplet x10 gly
Droplet x10 gly (adj)
Droplet x10 glu
Droplet x10 glu (adj)

Glyphosate (gly)
Glufosinate ammonium (glu)

Key findings

- Manually applied droplets work!
- Over 90% reduction in herbicide use in cabbages (74% in leeks)
- Three droplet treatments needed in cabbages (10 in leeks)
- Glufosinate-ammonium works but less effective than glyphosate
- Automated applicator: no spatter with nozzle 50 cm above paper target (1μL water droplets)

Automated machine trials planned for 2018 at Sonning Farm, Reading