Fast Blast® for better weedicide absorption and effective weed control

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1. INTRODUCTION

Effective weed management is a major challenge for growers. Weeds compete with crop species for water, nutrients and sunlight, and ultimately reduce crop yield. In severe cases they can lead to complete crop failure. Therefore, eradication of weeds from crop fields is essential for optimum crop production. Use of herbicides is one of the most cost effective and commonly used methods of weed control. However, the efficacy of chemical control of weeds depends on many factors. Systemic herbicides are absorbed by plants through their root systems or leaves, and then translocated throughout to kill the entire plant. Contact herbicides kill only the parts of the plant that come in contact with the chemical. For effective weed control, herbicides need to be adequately in contact with plants, absorbed, moved and elevated to toxic levels within the plant system. Herbicides are absorbed and move faster in actively growing plants over older or stressed plants.

Fast Blast® contains a number of 'bio stimulants', which stimulate the physiological functions of weeds during the weedicide application (if used in combination with weedicides). These stimulants aid in better absorption of weedicides, and thereby effective weed control. Fast Blast® consists of: 32.8% 17 different plant derived amino acids; 48.2% biologically active organic acid molecules (BAOM - patented product); and 8.2% other organic acids. This study aimed to discover the effects of Fast Blast® application alongside weedicides towards better weed management strategy.

Roundup Ultra® MAX (570 g/L Glyphosate, Sinochem Australia Pty Ltd, AU) and weedaster® AGRO (540 g/L Glyphosate, Nufarm Australia Ltd, AU) are two systemic herbicides and Spray.Seed® 250 (135 g/L Paraquat + 115 g/L Diquat, Syngenta Australia Pty Ltd, AU) is a contact herbicide. All three are commonly used to control a variety of weed species. While evaluating the efficacy of Fast Blast® in improving weed control when used with weedicides, this study does not compare or test the efficiency of any of the above-mentioned weedicide products.

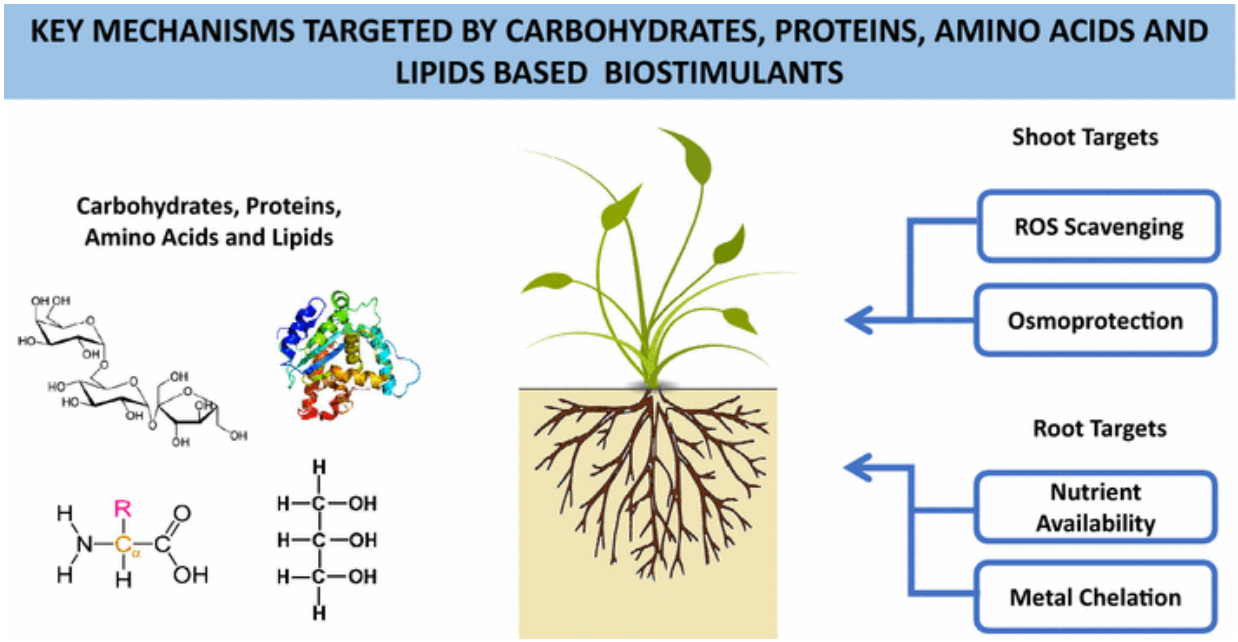


Figure 1. Summary of main key mechanisms targeted by carbohydrate, protein, amino acid, and lipid based biostimulants (Van Oosten et al. 2017).

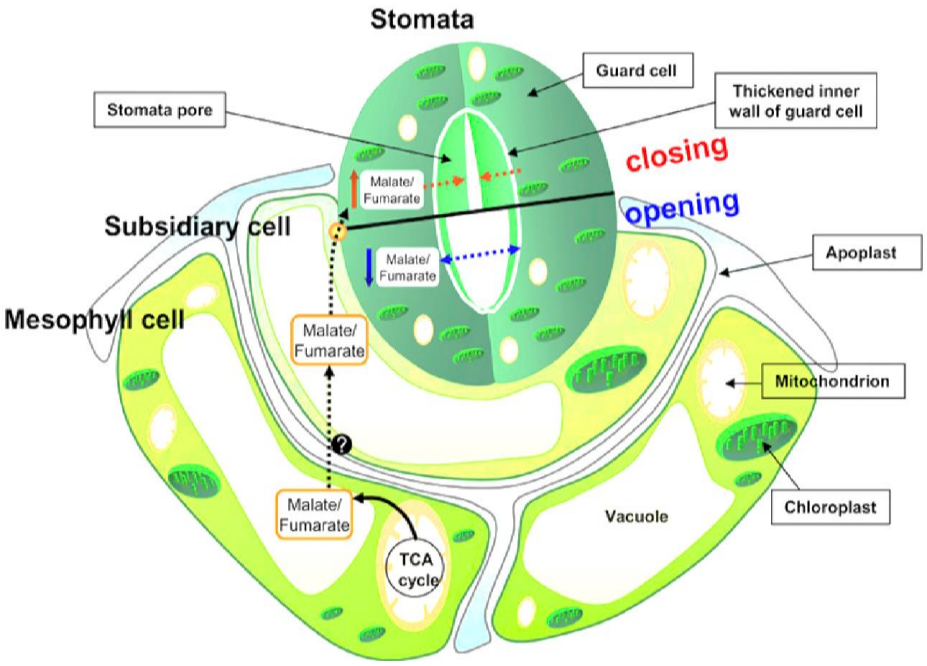


Figure 2. Mitochondrial function triggers stomatal movement by regulating organic acid levels (Araújo et al. 2011).

2. OBJECTIVES OF THE STUDY

The objective of this study was to evaluate the efficiency of Fast Blast® in improving weed control. The specific objectives were:

1. To evaluate the effect of Fast Blast® on improving weedicide absorption.
2. To examine the effectiveness of Fast Blast® in quickening weed control.
3. To assess the impact of Fast Blast® on hard-to-control weeds.
4. To assess the ability of Fast Blast® in suppressing regrowth of weeds.

3. TRIAL SITE AND DESIGN

This trial was conducted in Robinvale, Victoria (34°38′S 142°45′E). Three different sites with different weed profiles were selected and divided into treatment plots of 1m^2 area, with a buffer zone of ½ m^2 between the treatment plots. The treatment plots were arranged in Randomised Complete Block Design.

Table 1. Treatments and application rates

Treatments	Application rate
weedmaster® AGRO + Fast Blast®	70 mL/15 L + 20 mL/15 L
Roundup Ultra® MAX + Fast Blast®	95 mL/15 L + 20 mL/15 L
Spray.Seed® 250 + Fast Blast®	45 mL/15 L+ 20 mL/15 L
weedmaster® AGRO	70 mL/15 L
Roundup Ultra® MAX	95 mL/15 L
Spray.Seed® 250	45 mL/15 L
Control	Untreated

Garden Sprayer (Aqua Systems 2 L Pressure Sprayer) with a water rate of 500 mL/1 m^2 was used to make sure complete spray coverage.

Figure 3. Main weed species identified in the trial area.

Sow Thistle (*Sonchus oleraceus*)

Skeleton Weed (*Chondrilla juncea*)

Marshmallow (*Malva parviflora*)

Wild oats (*Avena fatua)*

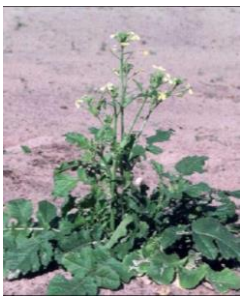
Prickly Lettuce (*Lactuca serriola*)

Flaxleaf Fleabane (*Conyza bonariensis*)

Wireweed (*Polygonum heterophyllum*)

Buckhorn plantain (*Plantago lanceolate*)

Annual ryegrass (*Lolium rigidum*)



Wild radish (*Raphanus raphanistrum*)

Caltrop (*Tribulus terrestris*)

Couch Grass (*Cynodon dactylon (L.) Pers*.

Table 2. Local weather data during the trial period

Dates	Min Temp °C	Max Temp °C	Rain Fall mm
22/11/2017	17.1	32.6	0
23/11/2017	17	31.6	0
24/11/2017	15.9	29.2	0
25/11/2017	16.9	30.5	1.8
26/11/2017	20.4	34.1	1.4
27/11/2017	15.8	30.9	0
28/11/2017	17	37.4	0
29/11/2017	22.2	38	0
30/11/2017	19.8	36.4	0
1/12/2017	20.6	25.8	6
2/12/2017	12.9	19	29.4
3/12/2017	8.3	19.4	4.4
4/12/2017	9.2	22.7	0
5/12/2017	8.9	26.2	0
6/12/2017	12.1	28.2	0
7/12/2017	10.9	21.1	0
8/12/2017	7.6	23.9	0.4
9/12/2017	9.9	30	0
10/12/2017	11	33	0
11/12/2017	14	36	0
12/12/2017	21	36.2	0

4. EVALUATION METHOD

4.1. Qualitative analysis of the control of weeds

Pictures of each treatment plot were taken every couple of days. The control of different weed species was assessed by analysing the population of live plants and dead plants in each plot by qualitatively assessing the pictures. Regrowth of weeds was also assessed qualitatively from the pictures.

4.2. Quantitative analysis

4.2.1. Residual Content of Glyphosate in the plant tissue

For the residual testing, the shoot system of weeds (up to a sample size of 50 g) was collected randomly from each treatment plot after two weeks of the treatment. Residue testing was done on two replicate samples for Roundup Ultra® MAX + Fast Blast® and Roundup Ultra® MAX treatment. The residual content of Glyphosate in the plant tissues was analysed at ACS Laboratories, VIC, Australia.

4.2.2. RGB Statistics of images

Image Colour Summarizer v0.07 was used to analyse the RGB colour space and channel statistics of each image (http://mkweb.bcgsc.ca/color-summarizer).

Examples of RGB histogram generated by Image Colour Summarizer

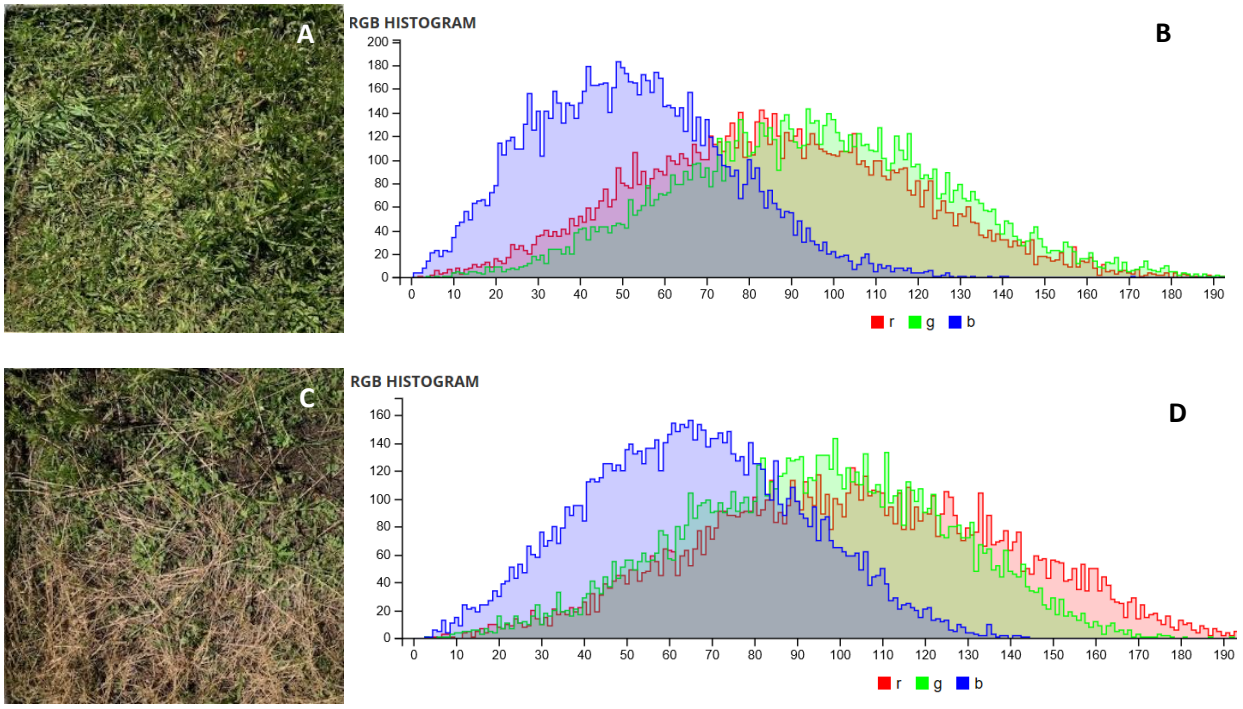


Figure 4. Shows RGB histograms B and D of colour images A and C respectively (See appendix 2 for details of colour pixel analysis of images by Image Colour Summarizer).

4.3. Statistical analysis of results

Ratio paired *t* test of RGB:G/RGB:R was performed to assess the significant difference between the images of weedicide only and weedicide + Fast Blast® treated plots. A *P* value <0.01 was considered to be significant. Prism 7 (Graph Pad Software) was used for the statistical analysis.

5. RESULTS

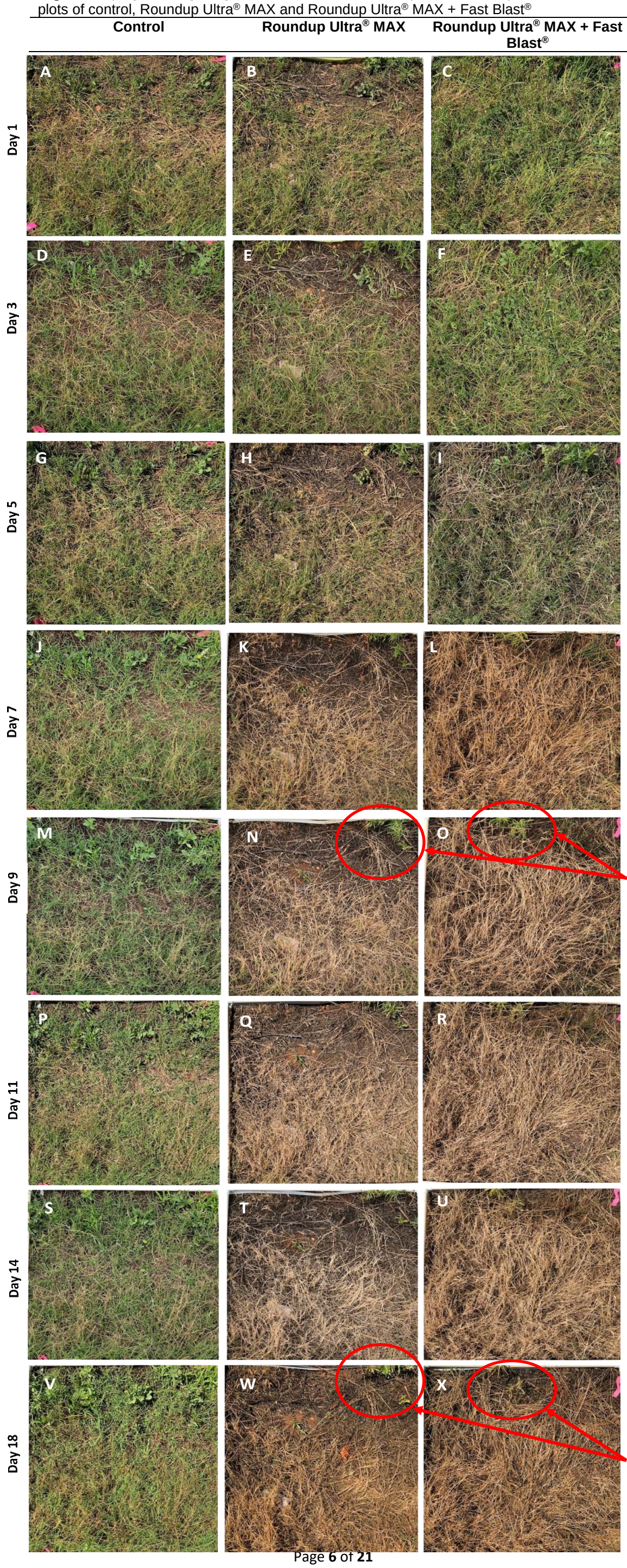
5.1. Qualitative analysis: Control of weeds and regrowth

Figures 5 to 11 show a faster and more effective control of weeds in the plots treated with the herbicides mixed with Fast Blast®. Regrowth of weeds was also found to be lesser in the plots treated with herbicides in combination with Fast Blast® (Figures 12 to 16). Observations of regrowth were taken from the 18th day after treatment for weedmaster® AGRO, weedmaster® AGRO + Fast Blast®, Roundup Ultra® MAX and Roundup Ultra® MAX + Fast Blast® treatments. Observations of regrowth were taken from the ninth day for Spray.Seed® 250 and Spray.Seed® 250 + Fast Blast® treatments.

5.2. Control of hard-to-control weeds

Figure 5N, 5O, 5W and 5X show the presence and death of Flaxleaf Fleabane in the plots treated with Roundup Ultra® MAX only and Roundup Ultra® MAX + Fast Blast®. A faster and more effective control of this weed was observed in the plot where Fast Blast® was used in combination with herbicide Roundup Ultra® MAX.

Figure 5. (**Replicate 1)** Progress of weed control over a period of 18 days in the treatment plots of control, Roundup Ultra® MAX and Roundup Ultra® MAX + Fast Blast®



Hard-to-control type weed Flaxleaf Fleabane in the plots treated with Roundup Ultra® MAX and Roundup Ultra® MAX + Fast Blast®.

A faster death of Flaxleaf Fleabane weeds was observed in the plots treated with Roundup Ultra® MAX + Fast Blast® compared to the Roundup Ultra® MAX only treated plot.

Figure 6. (Replicate 1) Progress of weed control over a period of 18 days in the treatment plots of control, weedmaster® AGRO and weedmaster® AGRO + Fast Blast®

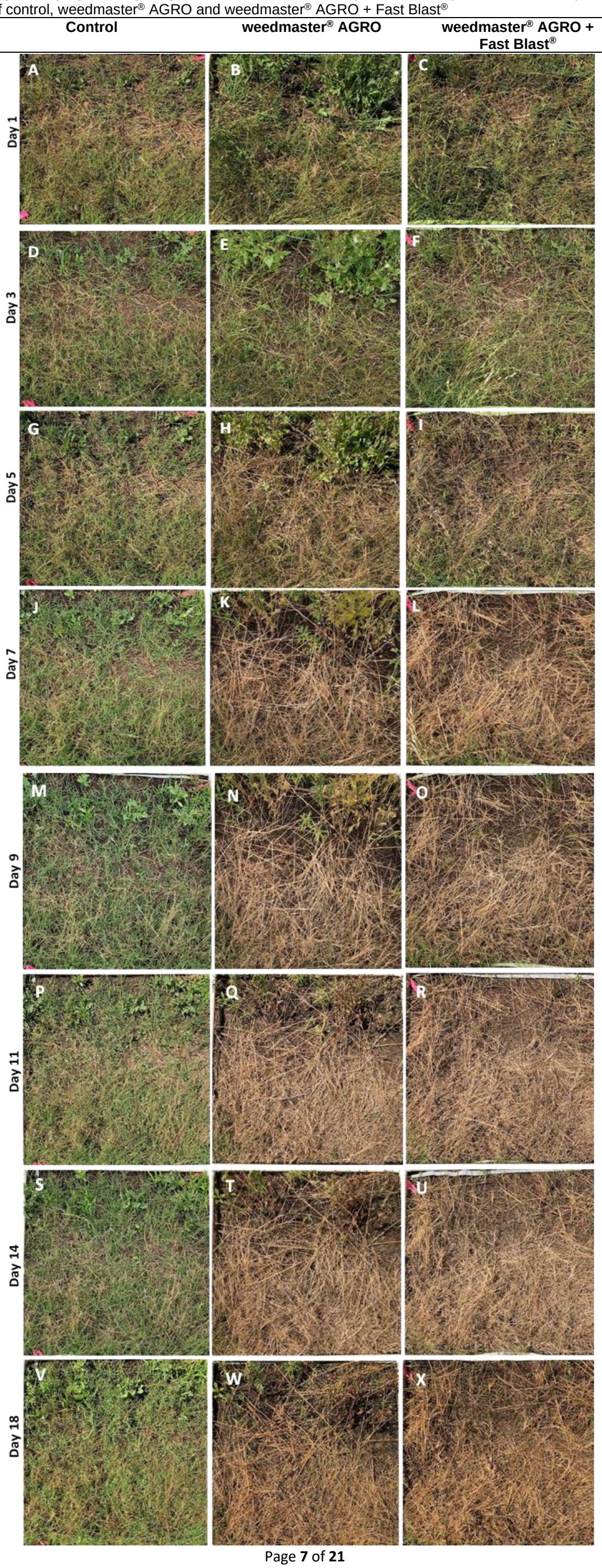


Figure 7. (Replicate 1) Progress of weed control over a period of 18 days in the treatment plots of control, Spray.Seed® 250 and Spray.Seed® 250 + Fast Blast®

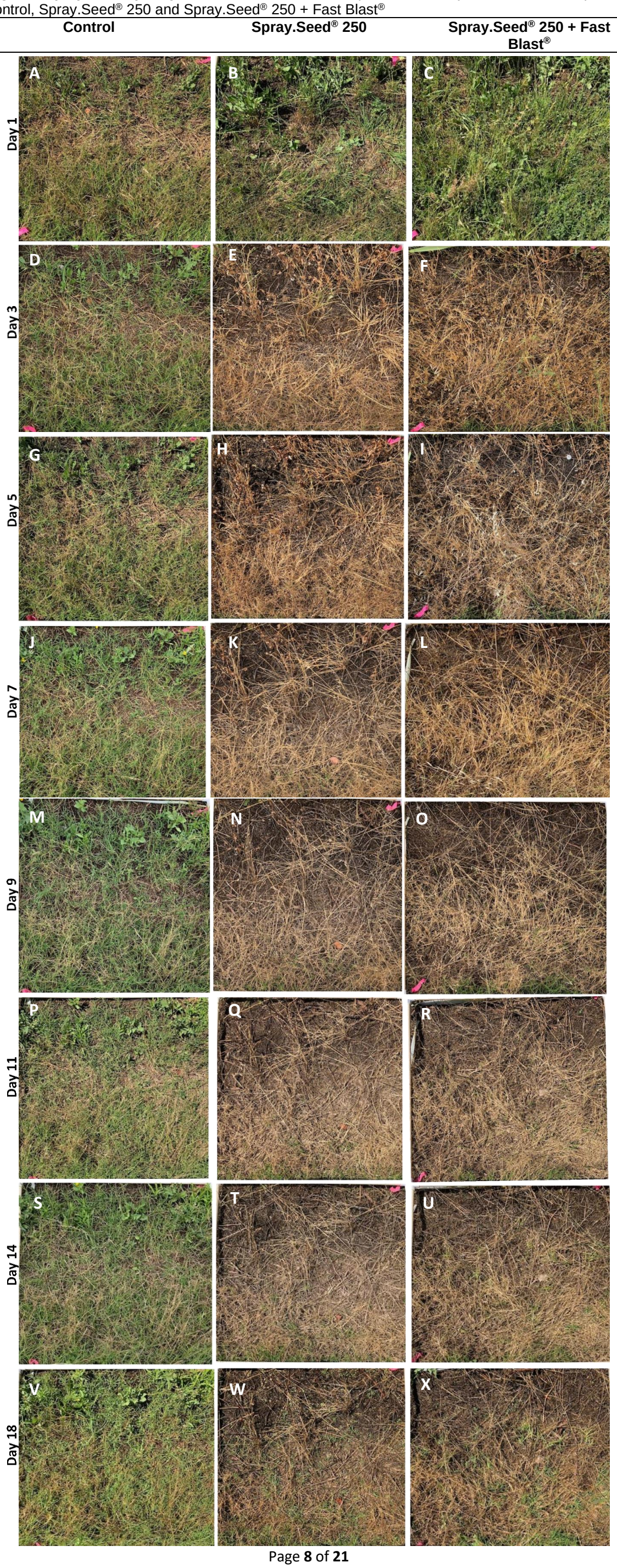


Figure 8. (Replicate 2) Progress of weed control over a period of 18 days in the treatment plots of control, Roundup Ultra® MAX and Roundup Ultra® MAX + Fast Blast®

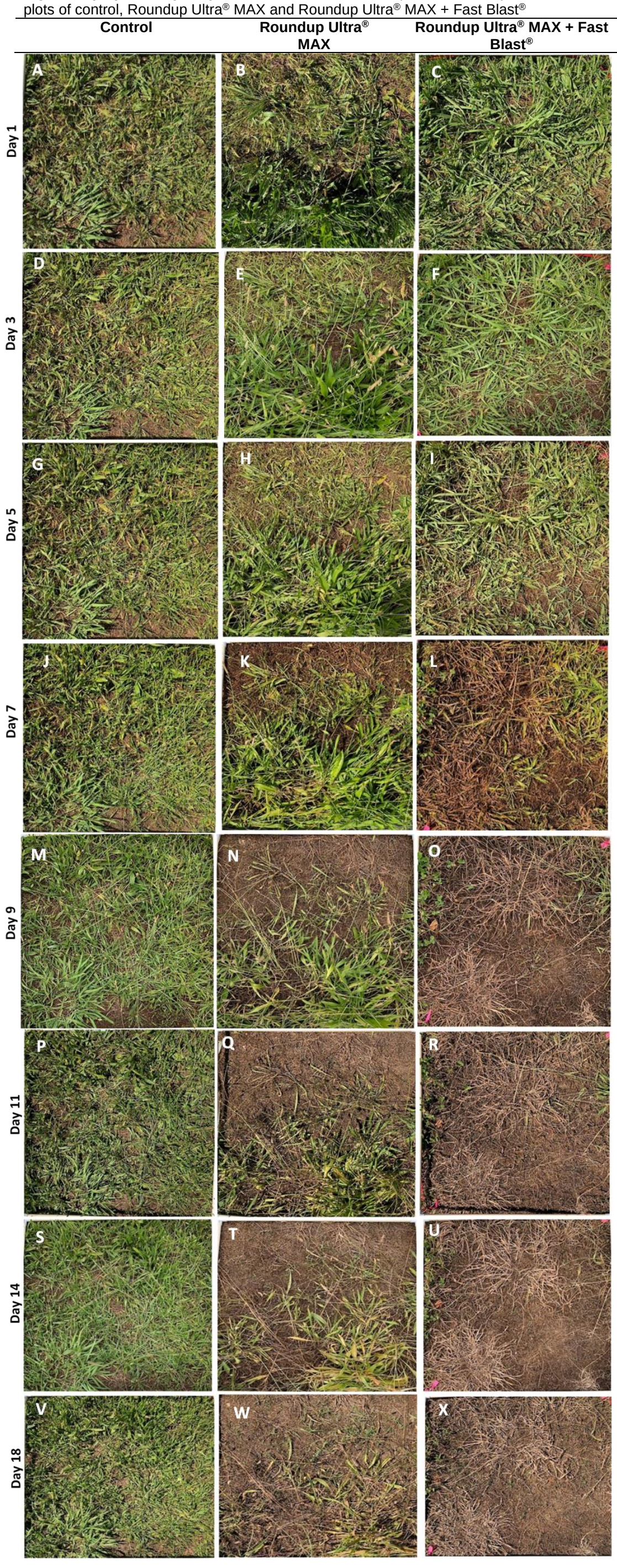


Figure 9. (Replicate 2) Progress of weed control over a period of 18 days in the treatment plots of control, weedmaster® AGRO and weedmaster® AGRO + Fast Blast®

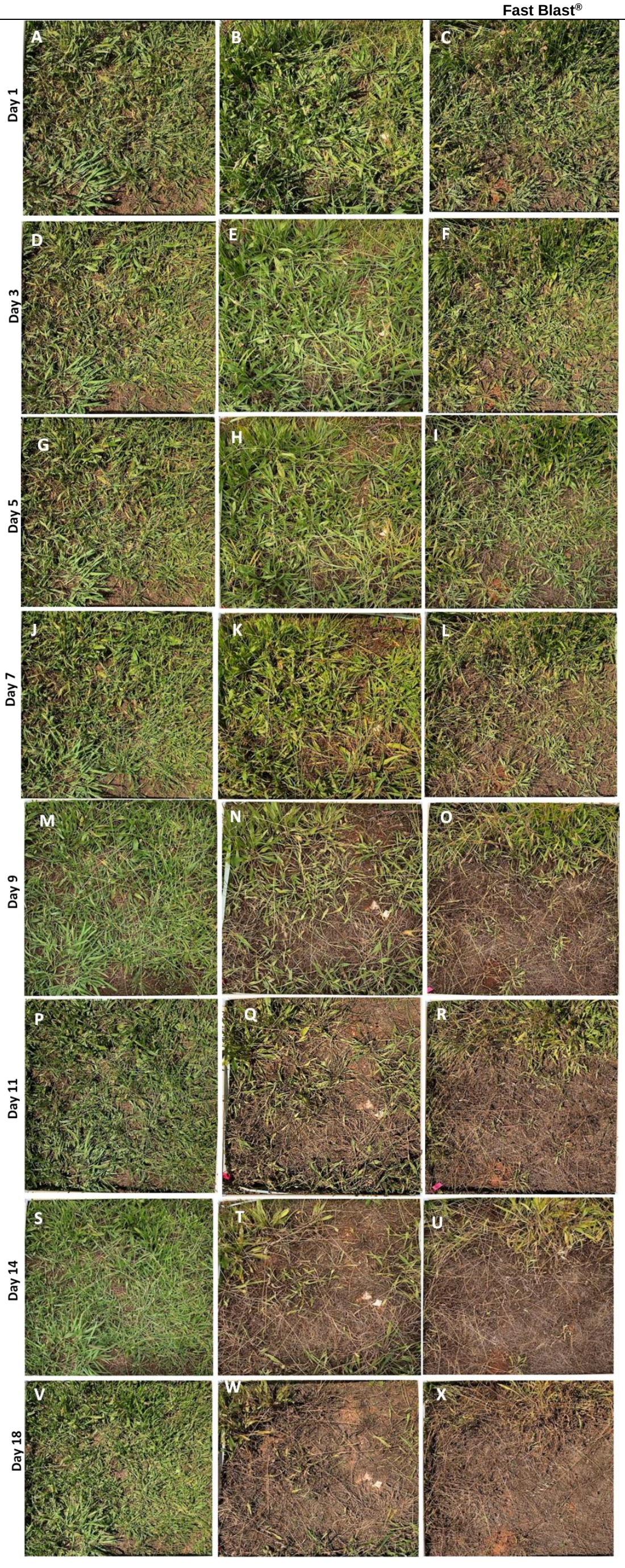


Figure 10. (Replicate 2) Progress of weed control over a period of 18 days in the treatment plots of control, Spray.Seed® 250 and Spray.Seed® 250 + Fast Blast®

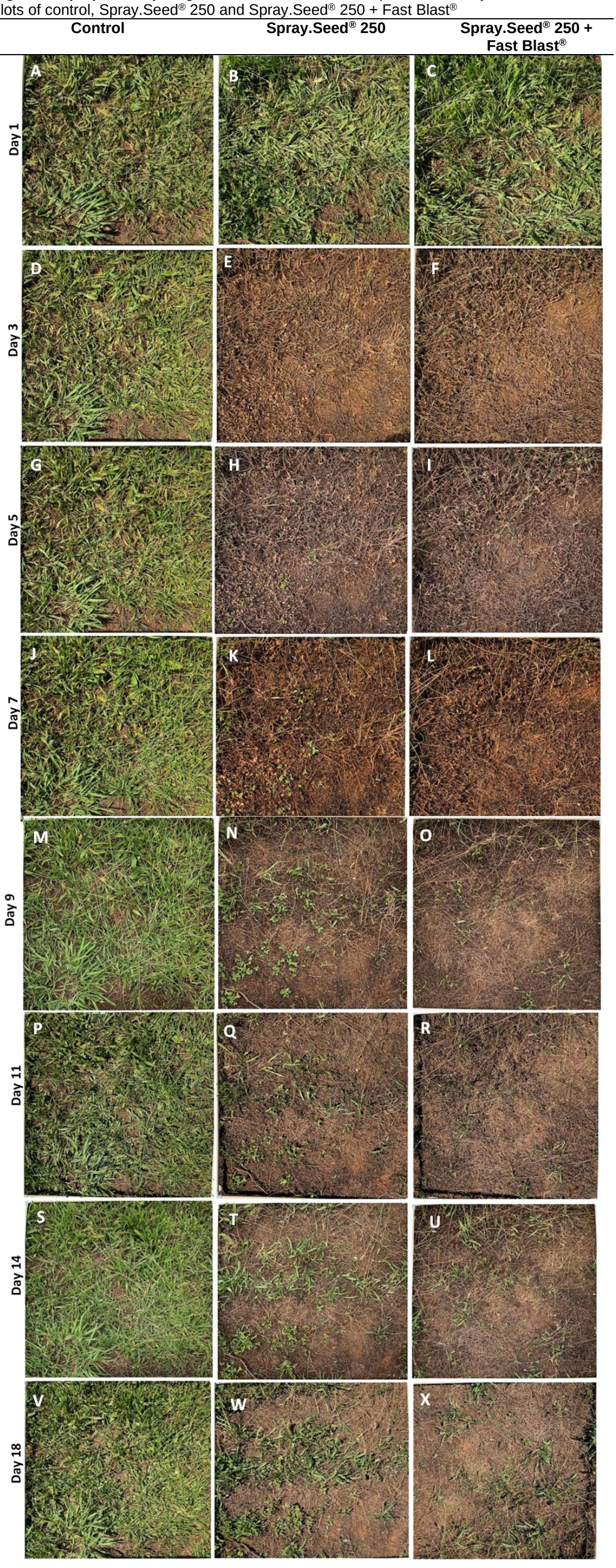


Figure 11. (Replicate 3) Progress of weed control over a period of 18 days in the treatment plots of control, weedmaster® AGRO and weedmaster® AGRO + Fast Blast®

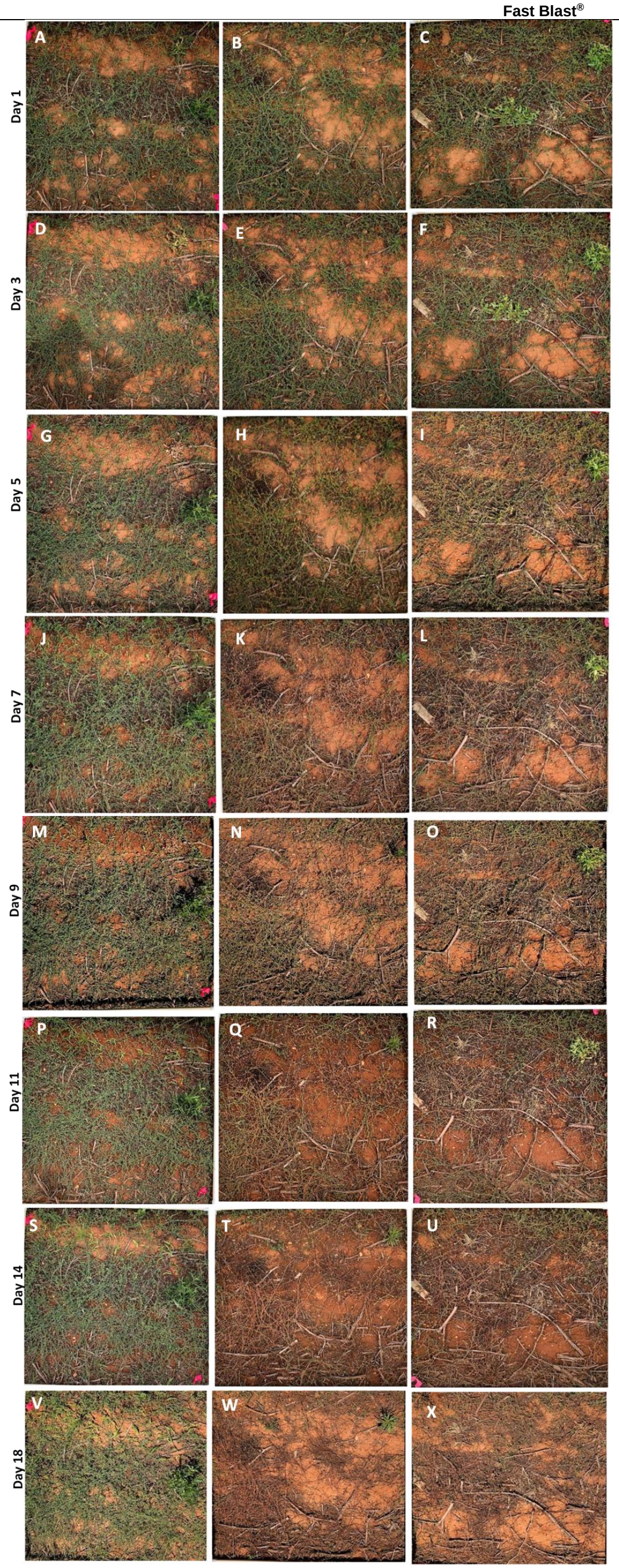


Figure 12. (**Replicate 1)** Regrowth pattern of weeds in the treatment plots of control, Roundup Ultra® MAX and Roundup Ultra® MAX + Fast Blast®

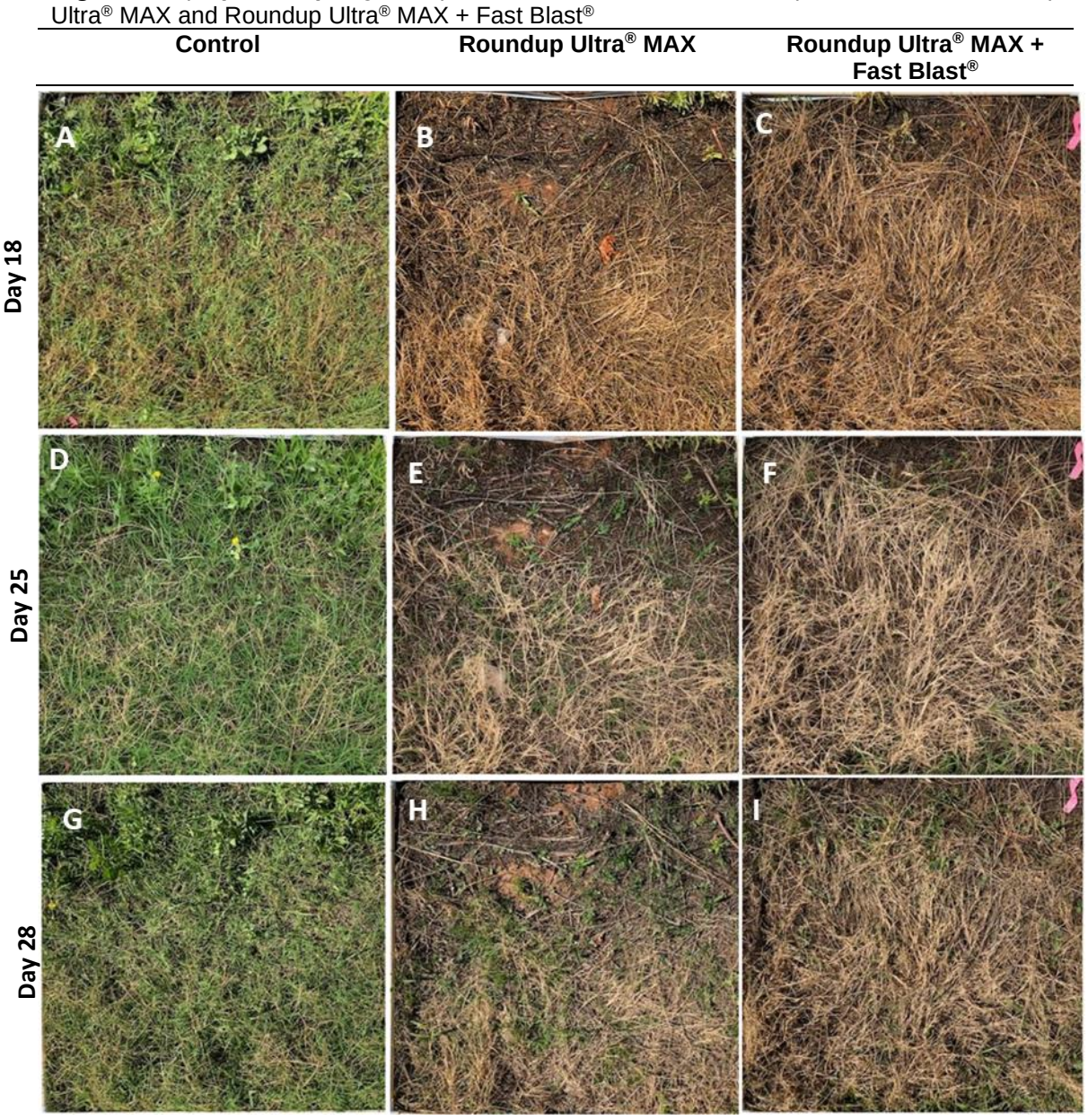


Figure 13. (Replicate 1) Regrowth pattern of weeds in the treatment plots of control, weedmaster® AGRO and weedmaster® AGRO + Fast Blast®

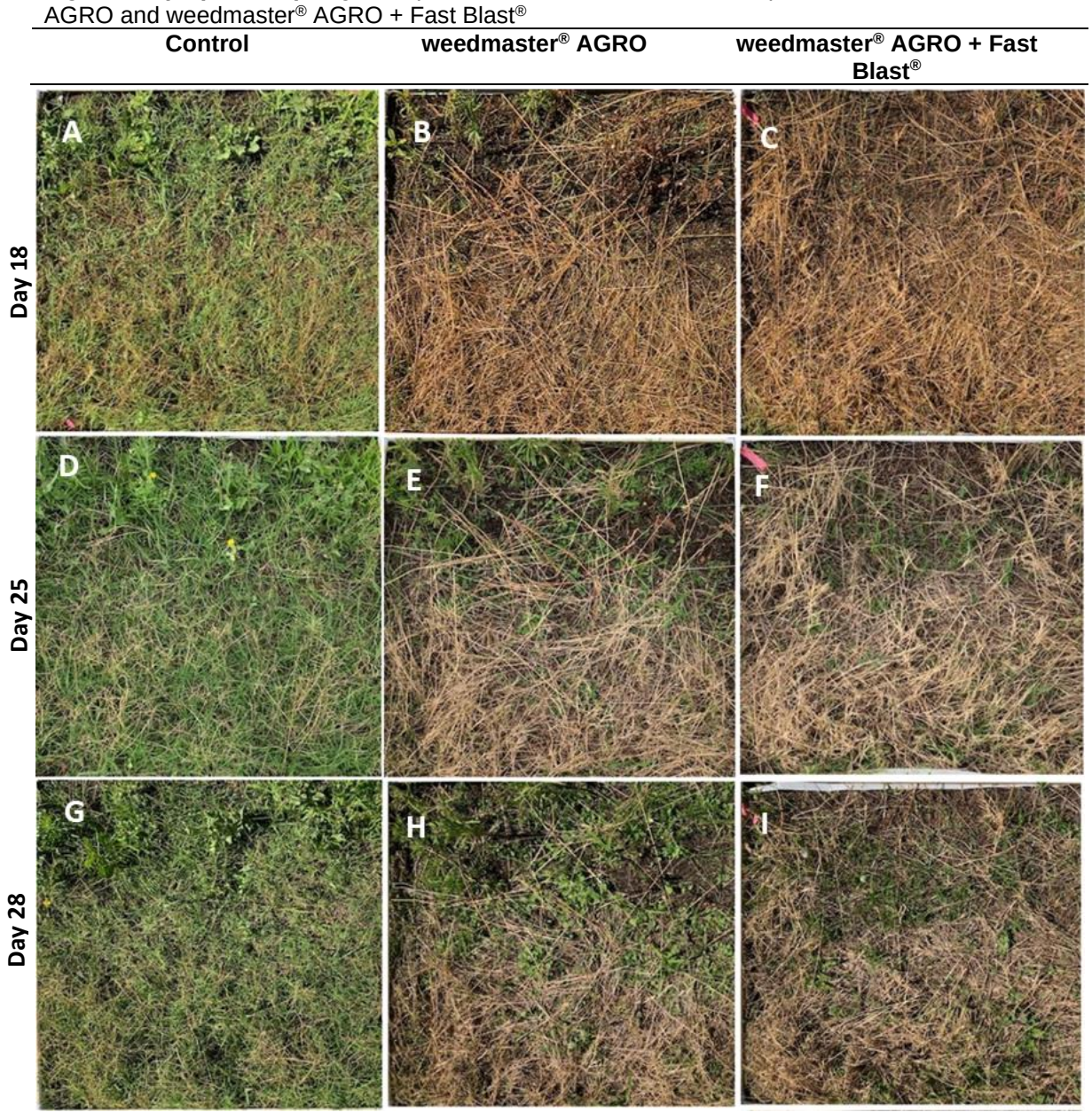


Figure 14. (**Replicate 1)** Regrowth pattern of weeds in the treatment plots of control, Roundup Ultra® MAX and Roundup Ultra® MAX + Fast Blast®

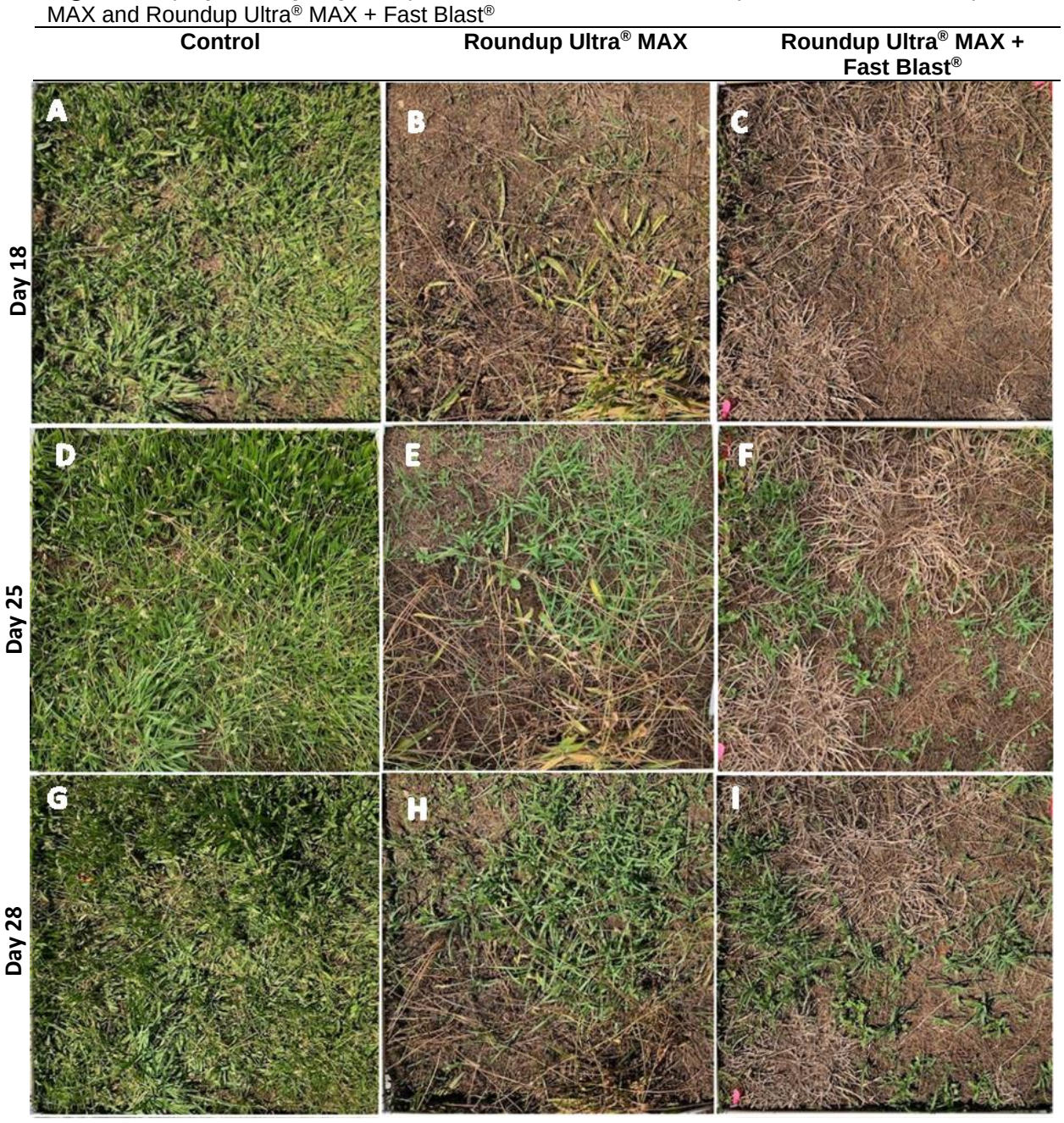


Figure 15. (Replicate 2) Regrowth pattern of weeds in the treatment plots of control, weedmaster® AGRO and weedmaster® AGRO + Fast Blast®

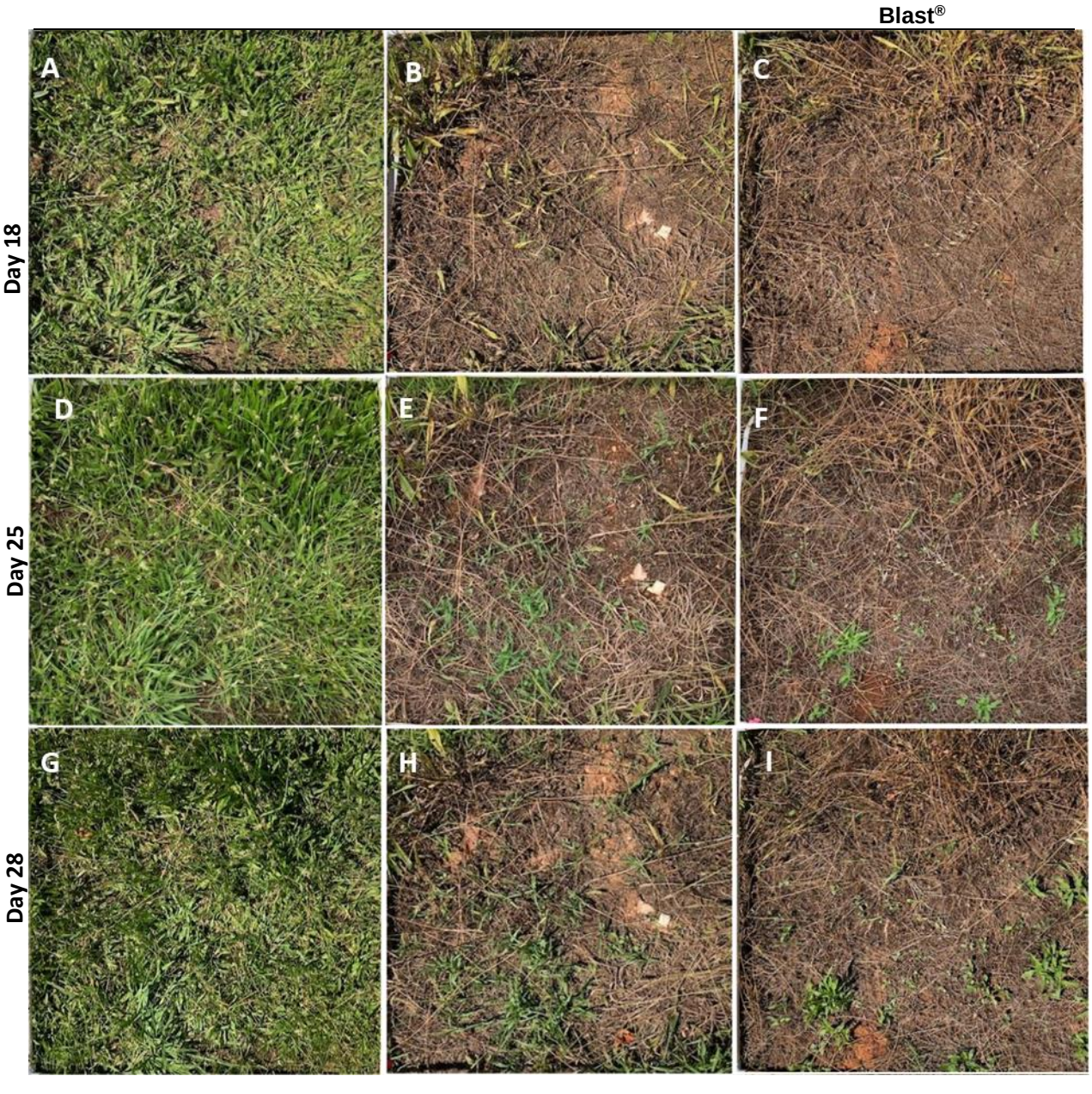
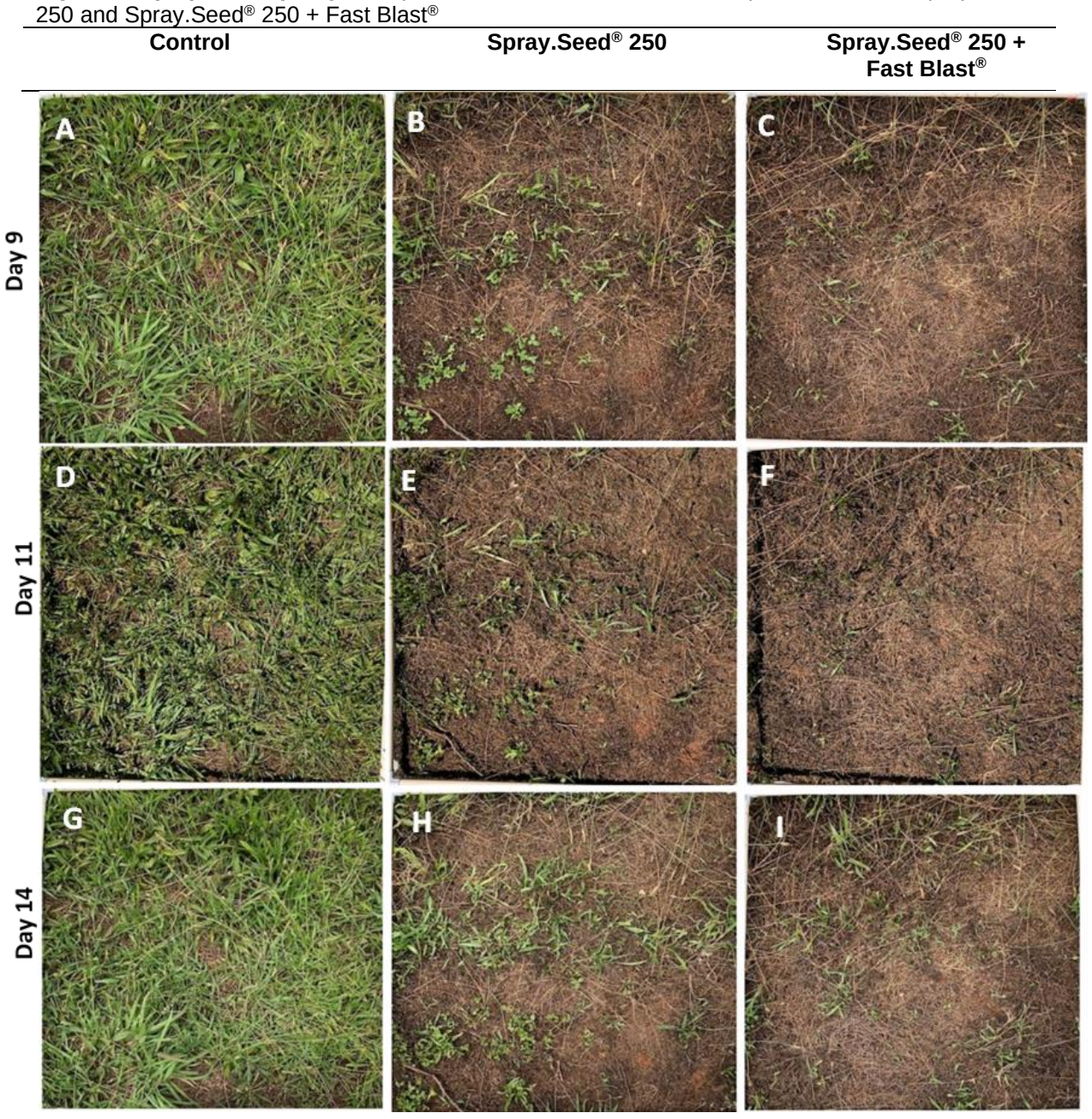


Figure 16. (Replicate 2) Regrowth pattern of weeds in the treatment plots of control, Spray.Seed® 250 and Spray.Seed® 250 + Fast Blast®



5.3. Effect on weedicide absorption

Analysis showed 59% higher Glyphosate content in the tissues of weeds treated with Roundup Ultra® MAX + Fast Blast® compared to Roundup Ultra® MAX treated weeds (Figure 17). The lab report of analysis is contained in Appendix 1. This demonstrates higher levels of weedicide absorption by weeds when Fast Blast® was used along with herbicides. It should be noted that there was a big rain event (29 mm) one week after the treatment, and the residues of herbicides on the surface of leaves were completely washed away. Glyphosate content was therefore detected from within the plant tissues.

Residual content of Glyphosate in the tissues of weeds

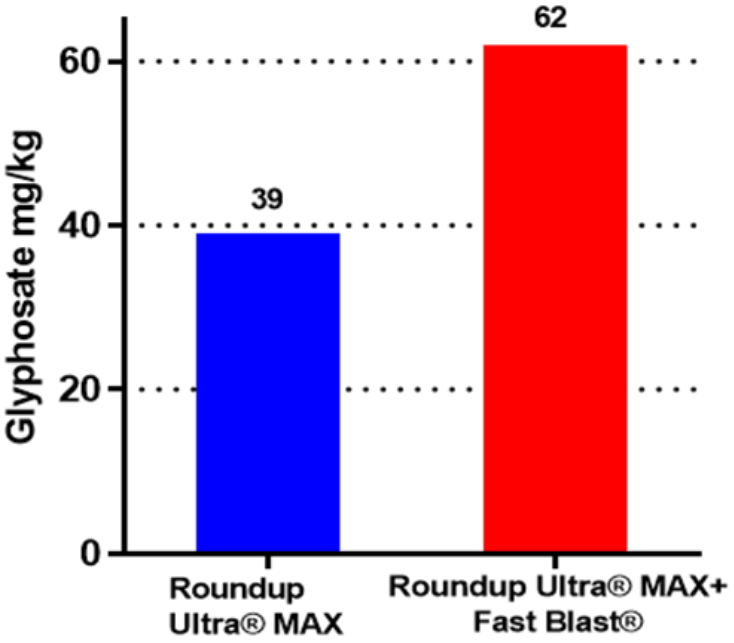


Figure 17. Shows the analysis of the residual content of Glyphosate in the tissues of weeds expressed as mg/kg.

5.4. RGB statistics of images

Figures 18 A, B and C show that the ratio of RGB:G to RGB:R was consistently lower in the images of treatment plots where the weedicides were mixed with Fast Blast® compared to the weedicides only treated plots - from the fifth day of treatment onwards. It should be noted that in Figures 18B and 18C, the green colour (green pixels) was higher in the beginning of the treatments, indicating that the weed population was higher in Roundup Ultra® MAX + Fast Blast® and Spray.Seed® 250 + Fast Blast® treated plots compared to Roundup Ultra® MAX and Spray.Seed® 250 treated plots respectively. The RGB:G to RGB: R colour analysis was also consistent with the qualitative analysis of regrowth (Figure 18).

There was highly significant difference (P<0.0001 for weedmaster® AGRO and weedmaster® AGRO + Fast Blast®, P<0.0007 for Roundup Ultra® MAX and Roundup Ultra® MAX + Fast Blast®, P<0.0007 for Spray.Seed® 250 and Spray.Seed® 250 + Fast Blast®) in the ratio of RGB:G to RGB:R between the herbicide only treatment compared to the treatments where herbicides were mixed with Fast Blast® (Table 3).

Ratio of RGB:G to RGB:R of the images of different treatments over a period of 28 days after treatment.

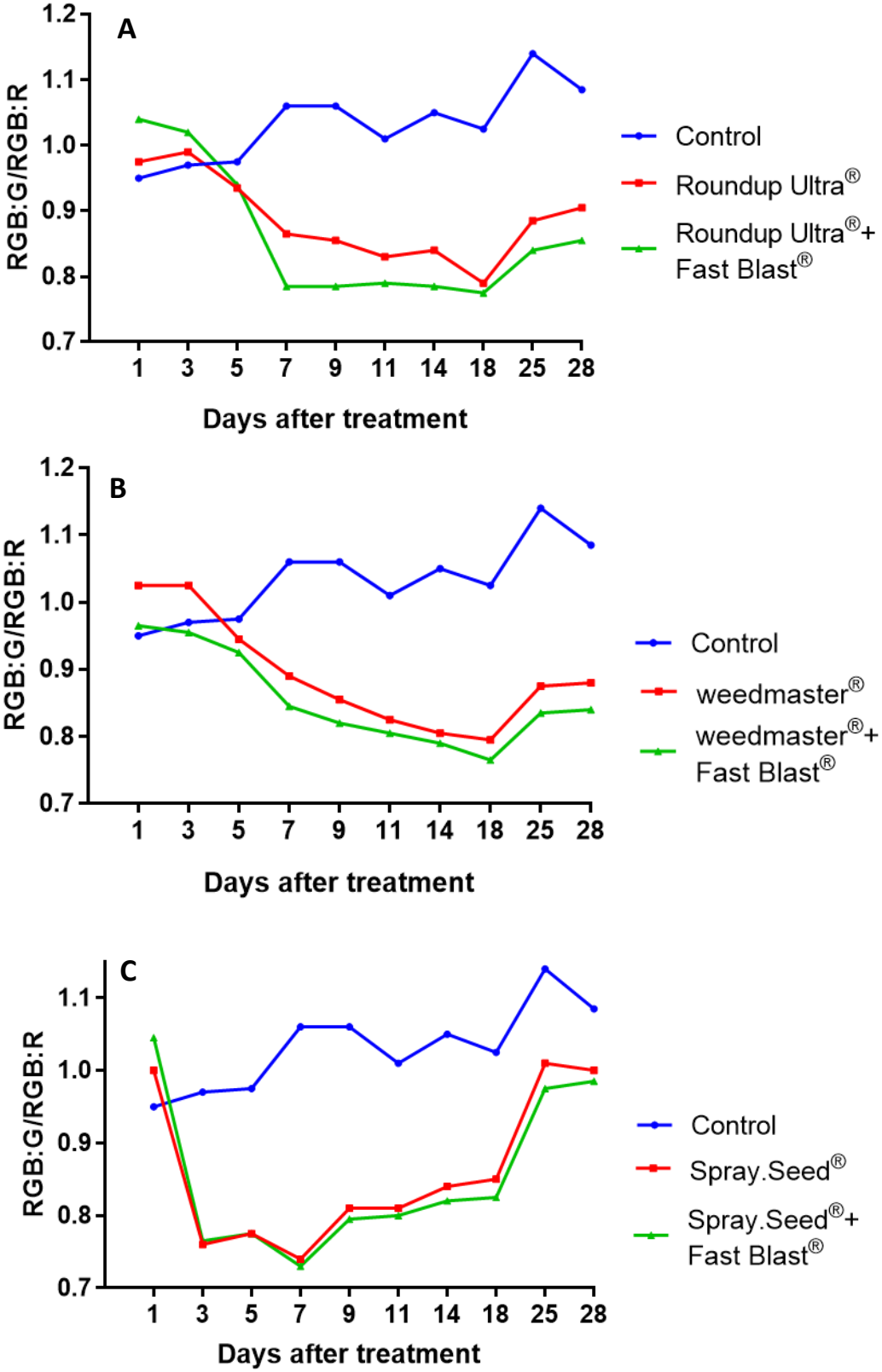


Figure 18. Ratio of RGB:G to RGB:R of the images of different treatments over a period of 28 days after treatment.

Table 3. Analysis of RGB colour space and channel statistics of images of different treatment plots.

Treatments		Geometric mean of ratios	SD of log(ratios)	SEM of log(ratios)	95% confidence interval	*P* value	Significance
weedmaster® AGRO	weedmaster® AGRO + Fast Blast®	0.9587	0.007356	0.002326	0.9472 to 0.9704	<0.0001	****
Roundup Ultra® MAX	Roundup Ultra® MAX + Fast Blast®	0.9407	0.0111	0.004196	0.9187 to 0.9632	0.0007	***
Spray.Seed® 250	Spray.Seed® 250 + Fast Blast®	0.9789	0.003799	0.001436	0.971 to 0.9869	0.0007	***

Ratio Paired *t* test of RGB:G to RGB:R ratio was performed for 10 pairs of weedmaster® AGRO vs weedmaster® AGRO + Fast Blast®, and 7 pairs each for the Roundup Ultra® MAX vs Roundup Ultra® MAX + Fast Blast® and Spray.Seed® 250 vs Spray.Seed® 250 + Fast Blast® treatments.

6. CONCLUSION AND RECOMMENDATION

This study clearly showed the efficacy of Fast Blast® in improving weedicide absorption and weed control in weedicide applications. Qualitative and quantitative analysis of images of treatment plots showed that a faster and more effective weed control was attained when herbicides were mixed with Fast Blast®. There was a highly significant difference in the weed control efficiency between the herbicide only treatments and herbicides + Fast Blast® treatments.

Statistical analysis of colour pixel (Table 3) shows that the *p* values <0.0001 – 0.0007 which validate the data > 99.99% significant.

An increase of 59% in the residual content of glyphosate was found in the tissues of weeds when Fast Blast® was used along with herbicides, which confirms that Fast Blast® promotes weedicide absorption. Also, Fast Blast® mixed herbicides were more effective in controlling resilient weeds such as Fleabane. In brief, Fast Blast® was found to be effective in:

- Better weedicide absorption by weeds;
- Faster weed control;
- Better control of resilient weeds;
- Inhibition of regrowth of weeds;

After the careful evaluation of the results from this study, use of Fast Blast® along with herbicides is strongly recommended for better absorption of herbicides by weeds and thereby better weed control.

7. REFERENCES

Araújo WL, Nunes-Nesi A, Osorio S, Usadel B, Fuentes D, Nagy R, Balbo I, Lehmann M, Studart-Witkowski C, Tohge T, et al (2011) Antisense inhibition of the iron-sulphur subunit of succinate dehydrogenase enhances photosynthesis and growth in tomato via an organic acid-mediated effect on stomatal aperture. *Plant Cell* 23: 600–627.

Van Oosten, M. J., Pepe, O., De Pascale, S., Silletti, S., and Maggio, A. (2017). The role of biostimulants and bioeffectors as alleviators of abiotic stress in crop plants. *Technol. Agric.* 4:5. doi: 10.1186/s40538-017-0089-5.

8. APPENDICES

Appendix 1. Lab report of glyphosate analysis in the plant tissues

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21 December 2017 **Report No. ACS1715814**

Tintu Baby
Dual Chelate Fertillizer Pty Ltd
PO Box 963
Robinvale VIC 3549

REPORT OF ANALYSIS

Dear Tintu,

Date of Sample Receipt: 6th December 2017
No. of Samples Received: 4

Table 1 Results (mg/kg)

Analyte	**Sample ID:** R, Sample 1 **Lab No:** 15814-1	**Sample ID:** R+DC Sample 2 **Lab No:** 15814-2
Glyphosate	39	62
AMPA	<0.1	<0.1

Method: ACS-TM-AM-029

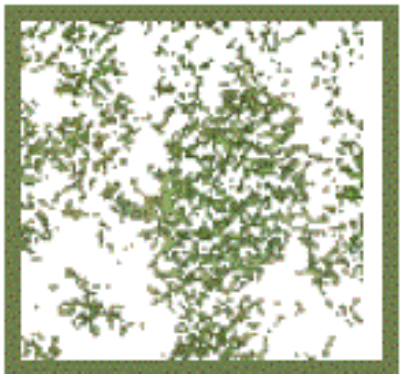
Yours faithfully,
ACS Laboratories (Australia)

Barry Blythman
Analytical Chemist

Appendix 2. Details of colour pixel analysis of images by Image Colour Summarizer.

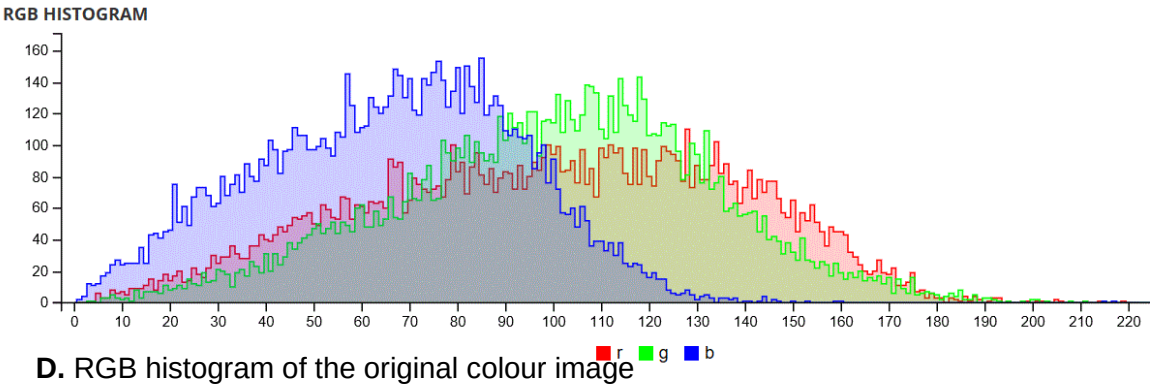
Figure 19. Image cluster partitions, RGB histogram and colour space and channel statistics of colour image of treatment plot.

A. Original colour image of 1 m^2 treatment plot



B. Cluster of pixels showing green plants

C. Cluster of pixels showing soil/dead weeds.



D. RGB histogram of the original colour image

COLOR SPACE AND CHANNEL STATISTICS

	avg	med	min	max
RGB:R	100	101	3	219
RGB:G	100	102	3	215
RGB:B	66	68	1	217

E. RGB colour space and channel statistics of the original colour image

Figure 19 shows the details of the colour pixel analysis of images. Colours in the image were clustered into groups. Pixels of the image assigned to each cluster. **A** - Original colour image of 1 m^2 treatment plot, **B** - Cluster of pixels showing green plants, **C** - Cluster of pixels showing soil/dead weeds. The border of pictures **B** and **C** is the colour of the cluster as calculated by the average value of its pixels. **D** - RGB histogram of the colour image, **E -** RGB colour space and channel statistics of the original colour image.

Appendix 3. Statistical analysis of results.