Informal Herbicide Control Trial Conducted on *Crocosmia crocosmiiflora* at Kaala MU

Introduction: This year an informal trial for chemical treatment of *Crocosmia crocosmiiflora* was conducted at Kaala. This taxon mostly spreads via vegetative growth and is documented to have low seed set. Its vegetative clumps become extremely dense and can exclude all other species. It occurs at the edge of the forest at Kaala where it is treated in several ICAs. The Army natural resource program on Oahu (OANRP) aims to prevent further spread into forested areas and establishment on steep slopes where future control would be impossible. It is also treated in ICAs at Palikea MU. Handpulling has been the standard method of control. However investigations into chemical controls seemed worthwhile in order to address 1) huge patches with too many corms to dig out, where initial sprays could significantly reduce patch biomass both above and below ground (sites 1 and 3), and 2) small populations where hand-digging is likely leaving small corms behind but where chemicals may translocate to corms and result in total elimination (site 2).

OANRP staff identified a promising herbicide mix utilized in New Zealand for control of *C. crocosmiiflora*, a documented invader there (https://www.weedbusters.org.nz/weed-information/weed-list/montbretia/

Purpose: to test efficacy of glyphosate 10ml/L (1%) + Escort XP 0.4g/L + surfactant: 4ml/L (0.4%) in controlling *C. crocosmiiflora*.

Site Description: Test herbicide mix was used at 3 *C. crocosmiiflora* sites. 1) An isolated patch near the landing zone approximately 20m² in size that is surrounded by alien grasses that are mowed/weedwhacked on a regular basis; 2) one of two drainages off the slopes of the Mt. Kaala FAA facility, covered with a dense, continuous infestation, with mixed native plants adjacent to and within the thickets of *C. crocosmiiflora*; 3) a 25 m² patch adjacent to native forest on one side, and the FAA facility on the other. At this third location, in January 2014 the patch was covered with weed mat for a year to determine if live underground corms could be killed via smothering. The weed mat may not have been thick enough, as corms sprouted beneath it, and the patch persisted and sent out new shoots when the mat was removed.

Method: Sites were treated on three occasions: Time 0, 12 months, and 16 months.

All live aboveground growth was treated at all three sites. At site 2, one area of the larger bowl was delineated and targeted for control. Here, more caution was given while spraying to avoid the surrounding native vegetation, however some overspray was inevitable on the interspersed native understory. Plants were sprayed with a backpack sprayer, and in the extremely dense thickets of *C. crocosmiiflora*, the sprayer wand was used to push blades of vegetation around to ensure complete herbicide coverage of all blades. A small amount of blue dye was also used in the mix to ensure thorough spray coverage. Sites were treated a year later, however unfortunately, the wrong mix was used, and only a negligible amount of glyphosate was added to the mix. At site 2, treatment was conducted in the original treatment area and was expanded to adjacent patches due to promising results seen at that time. Treatment was implemented at all sites again at 16 months.

Sites were monitored with anecdotal observations at 6 months post-treatment, at 12 months during the 2nd treatment, and at the 16 month treatment. Comparison photos were taken at Sites 1 and 2 and can be seen in Figures 1-3.

Monitoring observations:

Table 1. Observation summaries for each site

	6 months post-treatment observations	12 months post-treatment observations	16 months post-treatment observations
Site 1	At 6 months post-treatment, staff were surprised to see how effectively the sprays reduced the amount of aboveground biomass at each site. All existing vegetation had died back, and only a few new vegetative shoots occurred sparsely across the sites.	Dieback still evident and overall re-growth very low.	Faulty treatment relatively effective. Treated vegetation significantly yellowed and likely to die back completely given more time. No new shoots observed.
Site 2		Dieback still evident and overall re-growth very low. Sprays expanded here due to promising results and to begin process of vegetative reduction here.	Original site: Faulty treatment relatively effective. Treated vegetation significantly yellowed and likely to die back completely given more time. Few re-sprouts. Expansion site (4 months post-treatment with faulty mix): vegetation was completely brown and substantial reductions of aboveground biomass were observed, similar to what was seen with the complete cocktail mix. The effects of the Escort XP and the minimal amount of glyphosate was enough to have an impact as seen in Figure 4.
Site 3		Dieback still evident and overall re-growth very low	Faulty treatment relatively effective. Treated vegetation significantly yellowed and likely to die back completely given more time. No new shoots observed.

Discussion of preliminary results:

At 16 months post-treatment, staff were shocked to see the sheer amount of corms present in the soil. Without the vegetative cover, the chain-like growth as seen in Figure 5, became very evident on the original treatment slope at site 2. Hardly any corms had shoots at this time, but there was a range of how plump and fleshy remaining corms looked. Many were shriveled and turning black and were more obviously dead, whereas others were still plump and fleshy. The latter group was difficult to assess if were in the process of dying, or were merely dormant without further detailed study.

Based on the presence of black and shriveling corms on corm ‘chains’, staff ultimately suspect that the herbicide control is effective at killing the corms from which vegetative sprigs were emergent and treated during sprays.. It is likely that new shoots are emerging from corms that did not have vegetative material at the time of control. Therefore, repeated visits will be necessary, but waiting at least 6-12 months between control efforts is best to ensure vegetation has emerged from dormant corms.

This trial was very limited in obtaining quantitative data such as: 1) how effective is the herbicide at killing a single corm, 2) to how many corms in a chain can the herbicide translocate, 3) how long can a corm remain dormant? However, while the efficacy of the herbicide to reduce belowground biomass

remains unknown, based on the initial knockdown of aboveground biomass and length of suppression, it has been determined that the trialed treatment of Escort and Glyphosate is worthwhile to pursue operationally. Chemical sprays are much quicker to implement than hand-pulling, and do not require removal/disposal of huge amounts of biomass; in contrast, hand-pulled corms are bagged and taken to the baseyard where they are later sent to H-Power for incineration. Furthermore, chemical control may also be useful for small populations where the majority of the corms have been removed, but remaining ones have been difficult to eradicate because hand-pulling is likely to disrupt chains of corms and leave live ones behind. Total elimination of all associated corms may be more readily achieved by this chemical control.

Escort is an herbicide known for potential of non-target effects, so any control efforts should be closely monitored after treatment. In sensitive areas where there is absolute zero tolerance for non-target effects, handpulling may be the better option. Additionally, staff are currently only able to use this product at Kaala where it occurs at allowable sites according to the label such as utility rights-of way. This would include the sites that occur along the fenceline and on the Landing Zone.

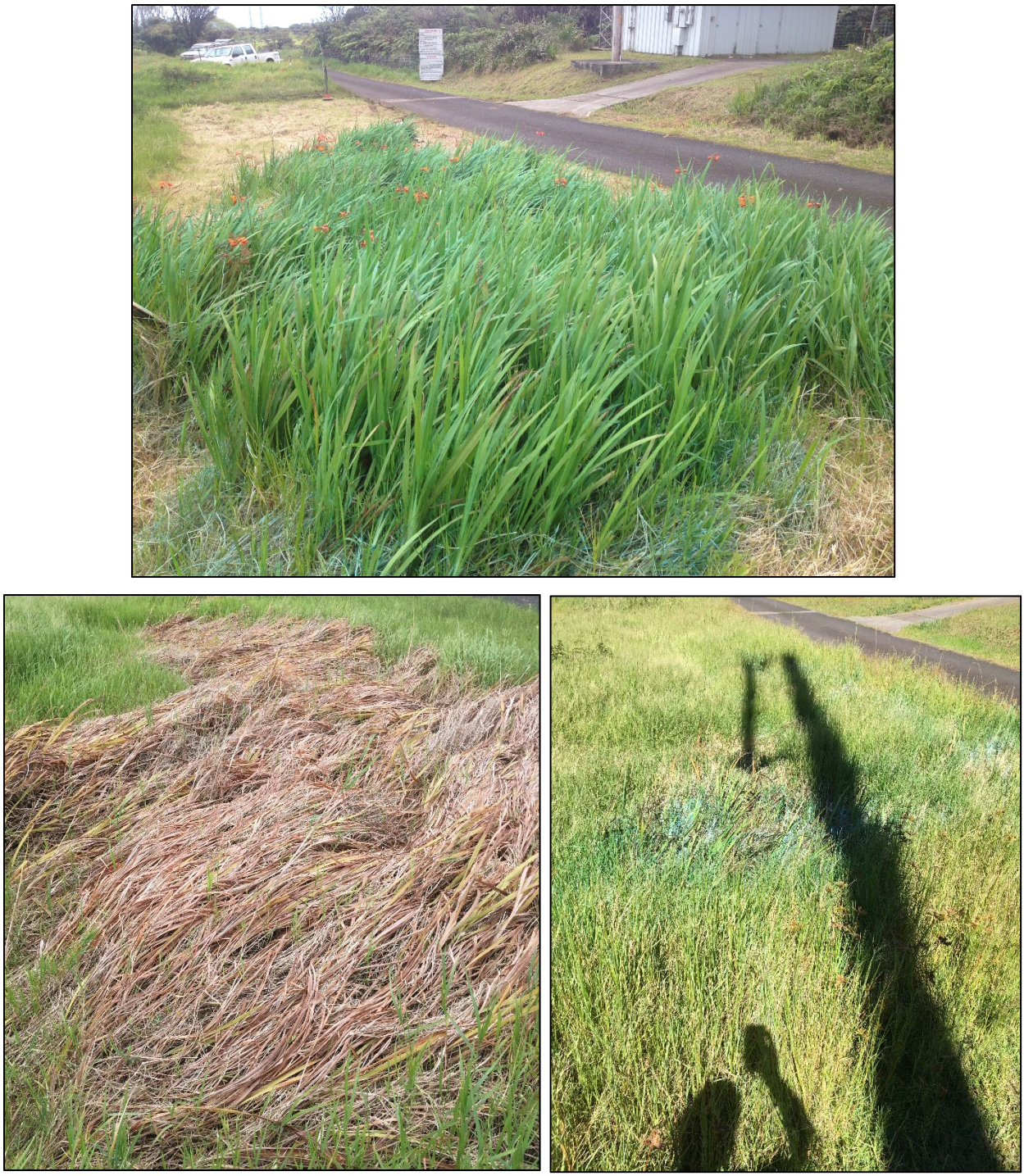

Figure 1. Photos at Site 1 during monitoring visits. Top: May 2016, initial spray of this isolated patch of dense plants. Some plants with mature flowers. Bottom left: September 2016, initial knockdown of biomass within 4 months. Bottom right: September 2017, only small shoots remain (colored blue from treatment) in the middle of tall grasses.

Figure 2. View one at Site 2. The arrows indicate photos taken through time at monitoring events starting with the top left on May, 2016 and running through September 2016, May 2017 and September 2017. The last photo is a close-up view showing how sparse the remaining vegetation is despite the high density of corms.

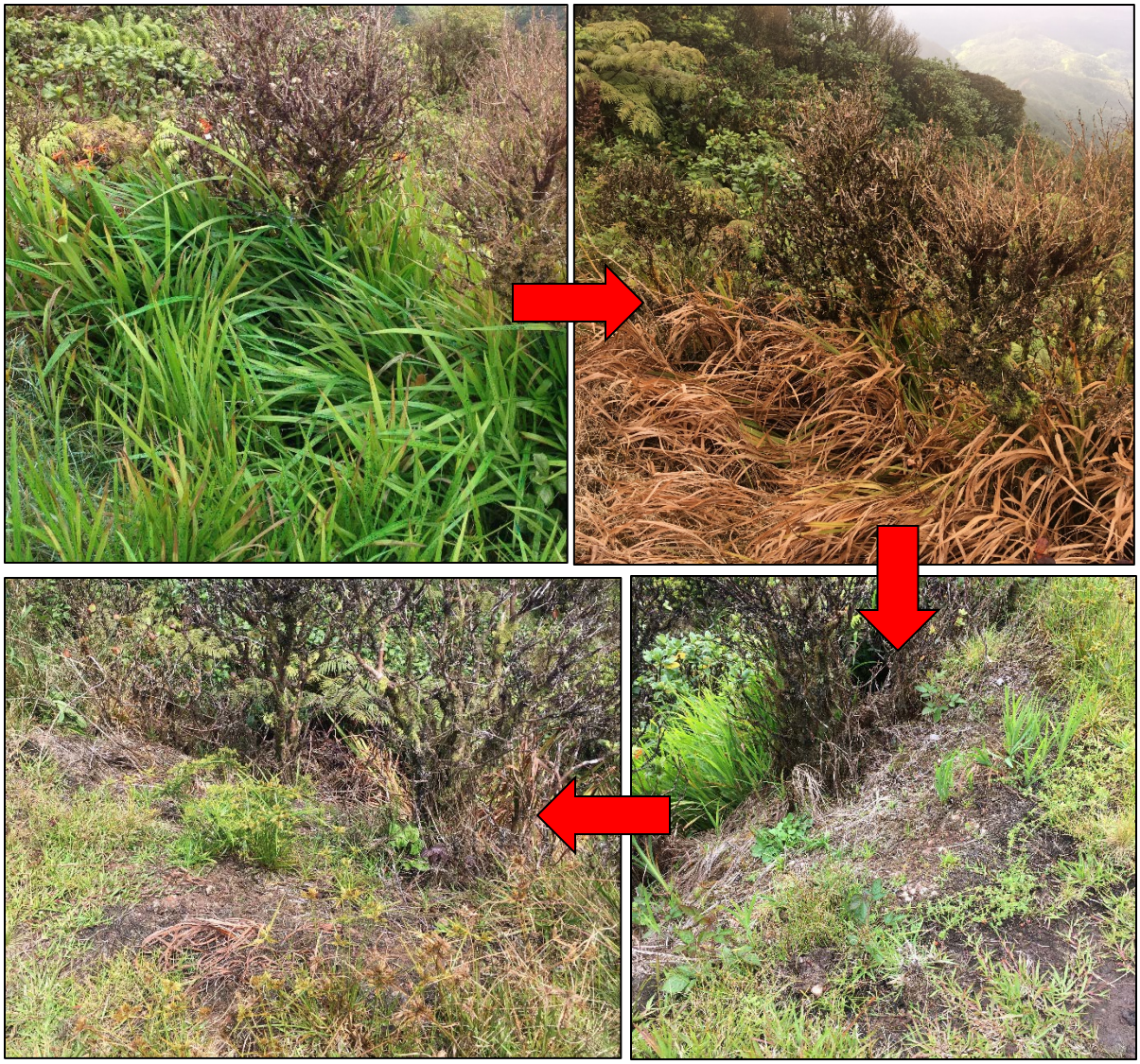

Figure 3. View two at Site 2. The arrows indicate photos taken through time at monitoring events starting with the top left on May, 2016 and running through September 2016, May 2017 and September 2017. While the photos are not taken from the same vantage point, the significant dieback under the Ohia trees, is evident. Dieback of Ohia in the treatment area was documented before control and was identified in other trees in the surrounding area pre-treatment.

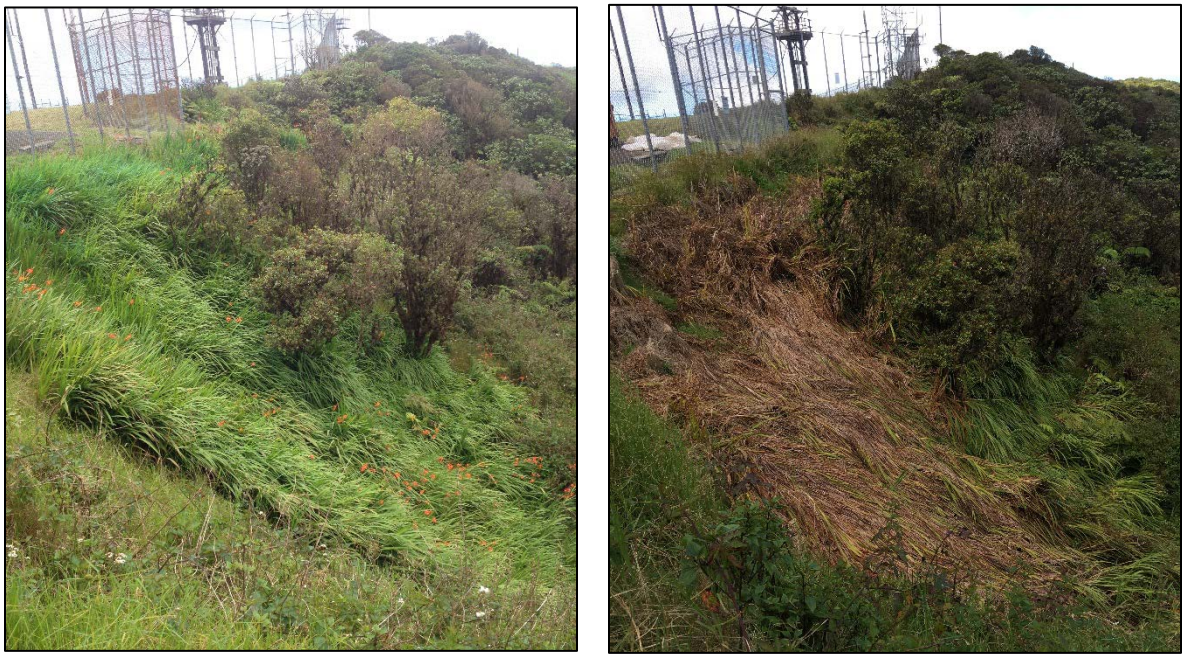

Figure 4. Pre- and 4-months post-treatment at Site 2 with ‘faulty’ spray mix. Dieback was evident, indicating that the Escort component of the mix was effective at reducing aboveground biomass.

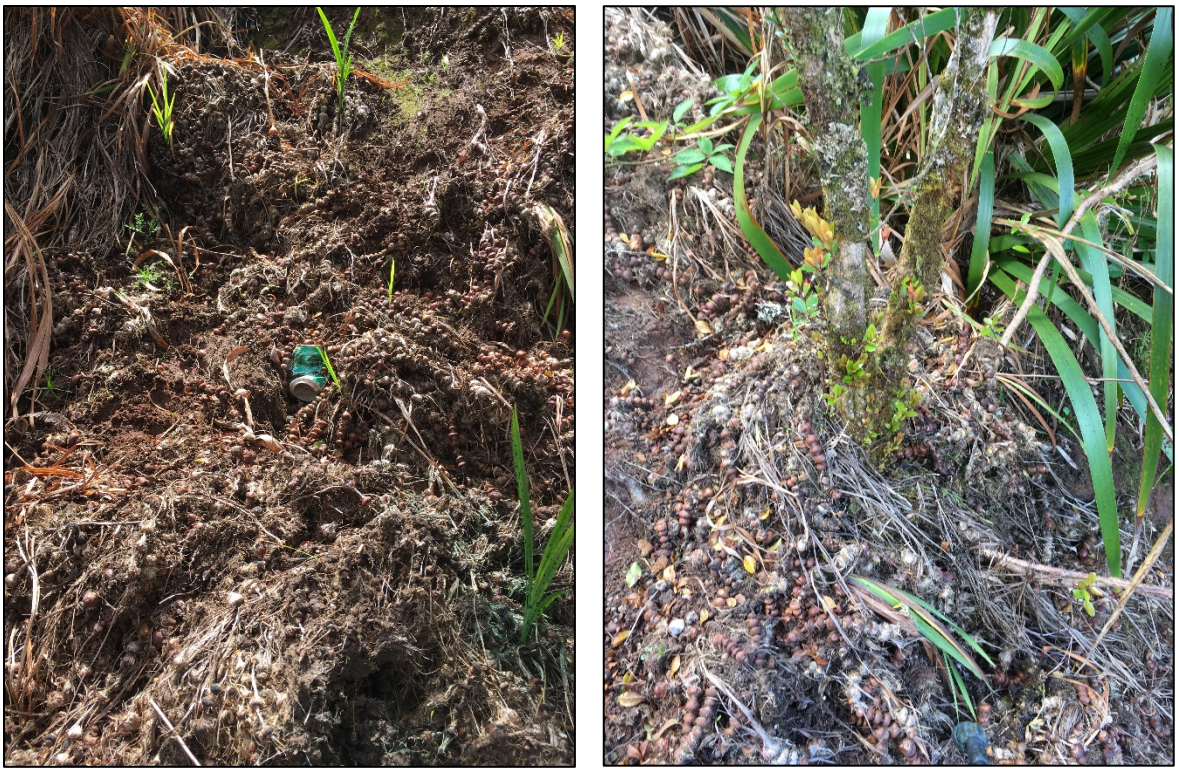

Figure 5. Photos of numerous corms remaining after 16 months. Some corms were withering while others remained plump. It is unknown if corms will eventually die off. Right photo indicates no adverse impacts to Ohia tree despite treatment of vegetation all around its base.