F .No 13035/07/2022-PP-I(e-110885)
Government of India
Ministry of Agriculture and Farmers Welfare
Department of Agriculture and Farmers Welfare
(Plant Protection Division)

347A, Krishi Bhawan, New Delhi,
Dated, the 12th April, 2022

Office Memorandum

Subject: Interim approval for application of already approved pesticide formulations through drones - reg.

The undersigned is directed to refer to the letter No. 108-189/2019-CIR-I dated 12th April,2022 received from CIB&RC on the subject mentioned above and to convey the approval of the competent authority for the following:

1) The registered pesticide formulations comprising of insecticides, fungicides and plant growth regulators (PGR's) (including bio-pesticides and botanical pesticides) which otherwise are permitted to be sprayed manually by knapsack sprayers in the areas along the lines of specifications mentioned in the SoP are hereby provisionally approved for commercial use through drones for a period of 02 years from the date of approval.

2) The applicants/registrants who wish to use already registered products for spray using drones (list enclosed at Annexure-1) shall intimate to the Secretariat of CIB&RC about the details of the products, dose and the crops for intended use along with action plan of data generation.

3) For spray using drones beyond the two year interim period of approval, the registrants shall have to generate the requisite data during the interim period as per RC approved guidelines for application with drones and get it endorsed with the approval of the Registration Committee.

4) The applicant/registrant/drone operator shall be solely liable to adhere to the requirements as prescribed in the "Standard Operating Procedure (SOP)

for use of drone application with pesticides for crop protection and for spraying soil and crop nutrients in agricultural, forestry, non cropped areas, etc."(copy enclosed at Annexure-2) and to follow the guidelines and safety measures prescribed by the Central Insecticides Board and Registration Committee as envisaged under Rule 43 of the Insecticides Rules, 1971.

This issues with approval of the Competent Authority.

Encls: As above.

18/04/22

(Ranjit Singh)

Director (PP)

To,

1. Plant Protection Advisor (PPA), DPPQS
2. APPA/Secretary(CIBRC), DPPQS
3. In charge IPM Division, DPPQ&S

Copy to :

1. PS to Hon'ble AM
2. PS to Hon'ble MoS
3. PS to Secretary, DA&FW
4. PS to AS(PP)
5. PS to JS (PP)
6. PS to JS(M&T)

Annexure-I

LIST OF ALREADY REGISTERED PESTICIDES FORMULATIONS FOR USE THROUGH DRONES:

Chemical Pesticides	
Sr. No.	**Formulation registered**
1.	Abamectin 1.9% EC
2.	Acephate 75% SP
3.	Acephate 95% SG
4.	Acephate 97% DF
5.	Acteamiprid 20% SP
6.	Afidopyropen 50g/l DC
7.	Alphacypermethrin 5% WP
8.	Alphacypermethrin 10% EC
9.	Alphacypermethrin 10% SC
10.	Alphanaphthyl Acetic Acid 4.5% SL
11.	Aureofungin 46.15% SP
12.	Azadirachtin (neemproducts) 0.03% EC
13.	Azadirachtin (neemproducts) 0.1% EC
14.	Azadirachtin (neemproducts) 0.15% EC
15.	Azadirachtin (neemproducts) 0.3% EC
16.	Azadirachtin (neemproducts) 1% EC
17.	Azadirachtin (neemproducts) 5% EC
18.	Azoxystrobin 23% SC
19.	Bendiocarb 8% WP
20.	Benfuracarb 40% EC
21.	Benzpyrimoxam 10% SC
22.	Beta-cyfluthrin 2.45% SC
23.	Bifenazate 22.6% SC
24.	Bifenazate 50% WP
25.	Bifenthrin 8% SC
26.	Bifenthrin 8.8% CS
27.	Bifenthrin 10% EC

28.	Bifenthrin 10% WP
29.	Bitertanol 25% WP
30.	Buprimate 26.7% EC
31.	Buprofezin 25% SC
32.	Captan 50% WP
33.	Captan 50% WG
34.	Captan 75% WS
35.	Captan 75% WP
36.	Carbendazim 46.27% SC
37.	Carbendazim 50% WP
38.	Carbosulfan 25% EC
39.	Carboxin 75% WP
40.	Carpropamid 27.8% SC
41.	Cartap Hydrochloride 50% SP
42.	CartapHydrochloride 75% SG
43.	Chlorantraniliprole 18.5% SC
44.	Chlorantraniliprole 35% WG
45.	Chlorfenapyr 10% SC
46.	Chlorfluazuron 5.4% EC(5% w/v)
47.	Chlormequat Chloride 50% SL
48.	Chlorothalonil 75% WP
49.	Chlorpyriphos 20% EC
50.	Chlorpyriphos 20% CS
51.	Chlorpyriphos 50% EC
52.	Chlorpyriphos75%WG
53.	Chlorpyriphos Methyl 40% EC
54.	Chroma fenozide 80% WP
55.	Clothianidin 50% WG
56.	Copper Hydroxide 46.1% WG
57.	Copper Hydroxide 77% WP
58.	Copper Oxychloride 50% WP
59.	Copper Oxychloride 50% WG
60.	Copper Oxychloride 56% OP

61.	Copper Sulphate 2.62% SC
62.	Cyantraniliprole 10.26% OD
63.	Cyazofamid 34.5% SC
64.	Cyenopyrafen 30.0% w/w SC
65.	Cyflufenamide 5% EW
66.	Cyflumetofen 20% SC
67.	Cyfluthrin 5% EW
68.	Cyfluthrin 10% WP
69.	Cymoxanil 50% WP
70.	Cypermethrin 0.1% Aqueous
71.	Cypermethrin 10% EC
72.	Cypermethrin 25% EC
73.	Cyphenothrin 5% EC
74.	Decamethrin (Deltamethrin) 1.25% ULV
75.	Decamethrin (Deltamethrin) 1.8% EC
76.	Decamethrin (Deltamethrin) 2% EW
77.	Decamethrin (Deltamethrin) 2.8% EC
78.	Decamethrin (Deltamethrin) 11% EC
79.	Diafenthiuron 47.8% SC
80.	Diafenthiuron 50% WP
81.	Dichloropropene and Dichloropropane mixture (DDMixture)*(R)
82.	Dicofol 18.5% EC
83.	Difenoconazole 3% WS
84.	Difenoconazole 25% EC
85.	Diflubenzuron 25% WP
86.	Dimethoate 30% EC
87.	Dimethomorph 50% WP
88.	Dinocap 48% EC
89.	Dinotefuran 20% SG
90.	Dithianon 75% WP
91.	Dodine 40% SC
92.	Dodine 65% WP
93.	Edifenphos 50% EC

94.	Emamectin Benzoate 1.9% EC
95.	Emamectin Benzoate5% SG
96.	Ethephon 39% SL
97.	Ethion 50% EC
98.	Ethofenprox (Etofenprox)10% EC
99.	Etoxazole10% SC
100.	Fenazaquin10% EC
101.	Fenazaquin 18.3% SC
102.	Fenitrothion R40% WP
103.	Fenitrothion R 20% OL(banned in agriculture use except for locust in Scheduled dessert area and public health)
104.	Fenobucarb (BPMC)50% EC
105.	Fenpropathrin 10% EC
106.	Fenpropathrin 30% EC
107.	Fenpyroximate 5% EC
108.	Fenpyroximate 5% SC
109.	Fenvalerate 0.4% DP
110.	Fenvalerate 20% EC
111.	Fipronil 0.6% WG
112.	Fipronil 2.92% EC
113.	Fipronil 5% SC
114.	Fipronil 18.87% SC
115.	Fipronil 80% WG
116.	Flonicamide 50% WG
117.	Flubendiamide 20% WG
118.	Flubendiamide 39.35% SC
119.	Flufenoxuron 10% DC
120.	Flumite 20% SC
121.	Fluopyram 34.48% SC
122.	Flupyradiflurone17.9% w/w SL
123.	Flupyrimin 10% SC
124.	Flusilazole 40% EC
125.	Fluvalinate 25% EC

126.	Fluxametamide 10% EC
127.	Forchlorfenuron (CPPU) 0.1%L
128.	Forchlorfenuron 0.12% EC
129.	Fosetyl-Al 80% WP
130.	Gibberellic Acid 0.001% L
131.	Gibberellic Acid 0.186% SP
132.	GibberellicAcid 0.45% SL
133.	GibberellicAcid 40% WSG
134.	Hexaconazole 2% SC
135.	Hexaconazole 5% SC
136.	Hexaconazole 5% EC
137.	Hexaconazole 75% WG
138.	Hexythiazox 5.45% EC
139.	Hydrogen Cyanamide 49% AS
140.	Hydrogen Cyanamide 50% SL
141.	Imidacloprid 17.1% SL
142.	Imidacloprid 17.8% SL
143.	Imidacloprid 30.5% SC
144.	Imidacloprid 70% WG
145.	Indoxacarb 14.5% SC
146.	Indoxacarb15.8% EC
147.	Iprobenfos(Kitazin) 48% EC
148.	Iprodione 50% WP
149.	Isoprothiolane 40% EC
150.	Kasugamycin 3% SL
151.	Kresoxim-methyl 44.3% (500g/l) SC
152.	Lambda-cyhalothrin 2.43% CS
153.	Lambda-cyhalothrin 2.5% EC
154.	Lambda-cyhalothrin 4.9% CS
155.	Lambda-cyhalothrin 5% EC
156.	Lambda-cyhalothrin 9.7% CS
157.	Lambda-cyhalothrin 10% WP
158.	Lambda-cyhalothrin 22.8% CS

159.	LimeSulphur 22% SC
160.	Lufenuron 5.4% EC
161.	Malathion 5% DP
162.	Malathion 25% WP
163.	Malathion 50% EC
164.	Malathion 96% ULV
165.	Mancozeb 35% SC
166.	Mancozeb 75% WG
167.	Mancozeb 75% WP
168.	Mandipropamid 23.4% SC
169.	MepiquatChloride 5% AS
170.	Meptyl dinocap 35.7% EC
171.	Metaflumizone 22% SC
172.	Metalaxyl 35% WS
173.	Metalaxylï M31.8%ES
174.	Methoxyfenazide21.8% SC
175.	Metiram 70% WG
176.	Metrafenone 500g/l SC
177.	Milbemectin 1% EC
178.	Monocrotophos R15% w/w SG
179.	Monocrotophos R 36% SL
180.	Myclobutanil 10% WP
181.	Novaluron 10% EC
182.	Novaluron 8.8% SC
183.	Oxathiapipron 10.1% OD
184.	Oxycarboxin 20% EC
185.	Oxydemeton-methyl 25% EC
186.	Paclobutrazol 40% SC
187.	Paclobutrazol 23%SC
188.	Penconazole10% EC
189.	Pencycuron 22.9% SC
190.	Permethrin 5% SG
191.	Permethrin 25% EC

192.	Phenthoate50%EC
193.	Phosalone 35% EC
194.	Picoxystrobin 22.52% SC
195.	Polyoxin D Zinc salt 5% SC
196.	Prochloraz 39.6% EC
197.	Profenophos 50% EC
198.	Prohexadionecalcium 10% WG
199.	Propergite 57% EC
200.	Propetamphos 20% EC
201.	Propiconazole 25% EC
202.	Propineb 70% WP
203.	Pymetrozine 50% WG
204.	Pyraclostrobin 100g/l CS
205.	Pyraclostrobin 20% WG
206.	Pyrethrum 2.0% EC
207.	Pyridaben 20% WP
208.	Pyridalyl 10% EC
209.	Pyriproxifen 10% EC
210.	Quinalphos 20% AF
211.	Quinalphos 25% EC
212.	Sodium para nitrophenolate 0.3% SL
213.	Sodium para nitrophenolate 1.8% SL
214.	Spinetoram 11.7% SC
215.	Spinosad 2.5% SC
216.	Spinosad 45% SC
217.	Spiromesifen 22.9% SC
218.	Spirotetramat 15.31% OD
219.	Sulfoxaflor 21.8% SC
220.	Sulphur 40% SC
221.	Sulphur 52% Flowable
222.	Sulphur 55.16% SC (800gm/L)
223.	Sulphur 80% WG
224.	Sulphur 80% WP

225.	Tebuconazole 2% DS
226.	Tebuconazole 25% WG
227.	Tebuconazole 25.9% EC
228.	Tebuconazole 38.39% SC
229.	Tetraconazole 11.6% w/w (12.5%w/v)SL
230.	Tetraconazole 3.8% EW
231.	Tetraniliprole 18.18% SC
232.	Thiacloprid 21.7% SC
233.	Thifluzamide 24% SC
234.	Thiocyclam hydrogen oxalate 50% SP
235.	Thiodicarb75% WP
236.	Thiomethoxam 25% WG
237.	Thiomethoxam 70% WS
238.	Thiomethoxam 75% SG
239.	Thiophanate-methyl 70% WG
240.	Thiophanate-methyl 70% WP
241.	Thiram 75% WS
242.	Tolfenpyrad 15% EC
243.	Triadimefon 25% WP
244.	Tricontanol 0.05% EC
245.	Tricontanol 0.1% EW
246.	Tricyclazole 70% WG
247.	Tricyclazole 75% WP
248.	Triflumezopyrim 10% SC
249.	Triflumizole 42.14% SC
250.	Validamycin 3% L
251.	Zineb75 % WP
252.	Ziram 27% SC
253.	Ziram 80% WP
Biopesticides Formulations registered	
254.	*Ampelomyces quisqualis* 2.0% A.S.(IPL/AQ/06)
255.	*Ampelomyces quisqualis* 2.0% WP (Aq-1MTCC-5683)
256.	*Bacillus subtilis*1.0% WP (CPBT15TCC-5527)

257.	*Bacillus subtilis* 1.5% LF (Bs-1,MTCC25072)
258.	*Bacillus thuringiensis var.galleriae* 1.3% FC
259.	*Bacillus thuringiensis var.sphaericus* 1.3% FC
260.	*Bacillus thuringiensis kurstaki* 0.5%WP Serotype 3a, 3b, 3c (DORBt-1, B-01118)
261.	*Bacillus thuringiensis kurstaki* 5% WP
262.	*Bacillus thuringiensis kurstaki* 2.5% AS Serotype 3a, 3b, 3c
263.	*Bacillus thuringiensis kurstaki* 3.5% ES Serotype 3a,3b,3c
264.	*Bacillus thuringiensis var. israelensis* 0.5% AS
265.	*Bacillus subtilis* 1.5% A.S. (BIL, BS-168)
266.	*Bacillus subtilis* 1.5% A.S. (KTSBMTCC5786)
267.	*Bacillus subtilis* 1.15% A.S
268.	*Bacillus subtilis* 2.0% A.S.(IPL/BS/09,MTCC-5728)
269.	*Bacillus thuringiensis var.israelensis* 5% AS, B-17 serotype H-14 (VCRC-B-17,MTCC-5596)
270.	*Bacillusthuringiensisvar.israelensis*0.5%WP
271.	*Bacillus thuringiensis var.israelensis* 5% WP
272.	*Bacillus thuringiensis var.israelensis* 12% AS
273.	*Bacillus thuringiensis var.4 rustaki,*serotype H-39, 3B, starin Z52
274.	*Beauveria basiana 1*.15% WP (Bb-1, MTCCNo.5171)
275.	*Beauveria basiana 1*.15% WP (BB-5372)
276.	*Beauveria basiana 1*.15% WP (ICAR-Umaim, NAIMCC-03045)
277.	*Beauveria basiana 1*.50% LF(Bb-1, MTCCNo.5171)
278.	*Beauveria bassiana* 1.00% WP (NBRI-9947)
279.	*Beauveria bassiana* 1.00% WP (SVBPU/CSP/BB-10/ITCC-7520)
280.	*Beauveria bassiana* 2.0%A.S.(IPL/BB/MI/01, 6897)
281.	*Beauveria bassiana* 5.0% SC (NBAI, ITCC7102)
282.	*Beauveria bassiana* 5.0% WP (IARI,7353)
283.	*Beauveria bassiana* 1.0% W.P.(SVBPU/CSP/Bb-10,ITCC-7520)
284.	*Beauveria bassiana* 1.15% WP(BB-ICAR-RJP,MCC-1022)
285.	*Hirsutellathompsonii* 2.0% A.S.(IPL/HT/01)
286.	*Metarhizium anisopliae* 2.0% SC (KSCL/Ma-59 ITCC-7058)

287.	*Metarhizium anisopliae* 1.15% WP (Ma-1MTCC5173)
288.	*Metarhizium anisopliae* 2.0% A.S (IPL/KC/44 ITCC-6895)
289.	*Metarhizium anisopliae* 1.15% WP (Ma-1MTCC-5173)
290.	*Metarhizium anisopliae* 1.50% LF (Ma-1MTCC5173)
291.	*Metarhizium anisopliae* 5.0% SC (NBAII,7103)
292.	*Metarhizium anisopliae* 1.00% WP (CPB/PSP-T26MTCC5699)
293.	*Metarhizium anisopliae* 1.00% WP (IPL/KC/44ITCC-6895)
294.	*Metarhizium anisopliae* 1.15% WP (NAIMCC-F-03037)
295.	NPV of *Helicoverpa armigera* 0.43% AS
296.	NPV of *Helicoverpa armigera* 0.5% AS
297.	NPV of *Helicoverpa armigera 1*% WP
298.	NPV of *Spodoptera litura* 2.0% AS
299.	NPVof *Spodoptera litura* 0.5% AS
300.	*Paecilomyces lilacinus* 1.0% S.P.(IIHR-PL-2ITCC-6887)
301.	*Paecilomyces lilacinus* 1.0% W.P.(IIHR-PL-2 ITCC-6887)
302.	*Paecilomyces lilacinus* 1.5% LF
303.	*Pseudomonas fluorescens* 0.5% W.P. (TNAU PF-1 ITCC BE-0005)
304.	*Pseudomonas fluorescens* 1.75% WP (PF-1 MTCC No.5671)
305.	*Pseudomonas flourescens* 1.5% LF (PF-1, MTCC No.5671)
306.	*Pseudomonas fluorescens* 0.5% W.P.(BIL-331 MTCC-5866)
307.	*Pseudomonas fluorescens* 1.0% W.P.(IPL/PS-01, MTCC-5727)
308.	*Pseudomonas fluorescens* 1.0% W.P.(IIHR-PF-2, ITCCB-0034)
309.	*Pseudomonas fluorescens* 1.5% A.S. (AS-AAIF,MCC2539)
310.	*Pseudomonas fluorescens* 1.5% WP
311.	*Pseudomonas fluorescens* 2.0% A.S. (IPL/PS-01)
312.	*Trichoderma harzianum* 1.0% WP (Th3, ITCC-5593)
313.	*Trichoderma ressei* 3.0% WP (CSR-T-3, NAIMCC-SF-0030)
314.	*Trichoderma viride* 2% W.P. (BHU, NAIMCC-F-02976)
315.	*Trichoderma viride* 0.50% W.P.
316.	*Trichoderma viride* 1.0% AS (TV-AAU-RJP,MCC-1013)
317.	*Trichoderma viride* 1.0% W.P. (Tv-1,ITCC-6914)

318.	*Trichoderma viride* 1.00% W.P. (BIL-198)
319.	*Trichoderma viride* 1.00% W.P.(IPL/VT/101)
320.	*Trichoderma viride* 1.00% W.P .(KAU,MTCC-5694)
321.	*Trichoderma viride* 1.00% W.P. (T-14)
322.	*Trichoderma viride* 1.5% LF (Tv-1, MTCC-5170)
323.	*Trichoderma viride* 5% LF(NAIM-F-03034)
324.	*Trichoderma viride*1.50%W.P.(IIHR-Tv-5,ITCC-6889)
325.	*Trichoderma viride* 5% WP
326.	*Trichoderma harzianum* 5.0% WP
327.	*Trichoderma harzianum* 5.0% SC(ITCC-7111)
328.	*Trichoderma harzianum* 0.5% WS (T-39)
329.	*Trichoderma harzianum* 1.0% W.P. (IIHR-Th-2, ITCC-6888)
330.	*Trichoderma harzianum* 2.0% A.S.(IPL/VT/102 6893)
331.	*Trichoderma harzianum* 2.0% WP (NBRI-1055)
332.	*Verticilium lecanii* 1.50% LF (Vl-1,MTCCNo.5172)
333.	*Verticillium chlamydosporium* 1.0% W.P.(IIHR-VC-3,ITCC6898)
334.	*Verticillium lecanii* 2.0% A.S.(IPL/VL/05)
335.	*Verticillium lecanii* 5.0% SC (NBAII2638)
336.	*Verticillium lecanii* 1.15% WP (AAI,NAIMCC-F-03007)
337.	*Verticillium lecanii* 1.15% WP (AS-MEGH-VL, MCC-1028)
338.	*Verticillium lecanii* 1.15% WP (Vl-1,MTCCNo.5172)
APPROVED FORMULATIONS OF COMBINATION PESTICIDES	
A.INSECTICIDES	
Sr No.	**Formulation registered**
1.	Acephate 25% + Fenvalerate 3% EC
2.	Acephate 50% + Bifenthrin 10% WDG
3.	Acephate 50% + Fipronil 5% WDG
4.	Acephate 50% + Imidacloprid 1.8% SP
5.	Acetamiprid 0.4% + Chlorpyriphos 20% EC

6.	Acetamiprid 1.1% + Cypermethrin 5.5% EC
7.	Betacyfluthrin 8.49% + Imidacloprid 19.81% OD
8.	Bifenthrin 3%+ Chlorpyriphos 30% EC
9.	Buprofezin 20% + Acetamiprid 2% WP
10.	Buprofezin 15%+ Acephate 35% WP
11.	Buprofezin 20% + Acephate 50% WP
12.	Buprofezin 20% + Acetamiprid 2% WP
13.	Buprofezin 22.0% +Fipronil 3.0% SC
14.	Buprofezin 23.1% + Fipronil 3.85% SC
15.	Buprofezin 9.0% + Acephate 24.0% WP
16.	Cartaphydrochloride 50%+ Buprofezin 10% WP
17.	Chlorantraniliprole 4.3% + Abamectin 1.7% SC
18.	Chlorantraniliprole 8.8% +Thiamethoxam 17.5% SC
19.	Chlorantraniliprole 9.3% +Lambdacyhalothrin 4.6% ZC
20.	Chloropyriphos 16% + Alphacypermethrin 1% EC
21.	Chlorpyriphos 50% +Cypermethrin 5% WG
22.	Chlorpyriphos 50% + Cypermethrin 5% EC
23.	Cyclanilide 2.10% + MepiquatChloride 8.40% SC
24.	Cypermethrin 10% +Indoxacarb10% SC
25.	Cypermethrin 3% + Quinalphos 20% EC
26.	Deltamethrin 0.72% + Buprofezin 5.65% EC
27.	Diafenthiuron 30% + Pyriproxifen 8% SE
28.	Difenthiuron 47.0% + Bifenthrin 9.4% SC
29.	Dinotefuran 15% + Pymetrozine 45% WG
30.	Dinotefuran15% + Pymetrozine 45% WG
31.	Dinotefuran 4% +Acephate 50% SG
32.	Emamectin benzoate 1.5% + Profenofos 35% WDG
33.	Emamectin Benzoate 1.5% + Fipronil3.5% SC
34.	Emamectin Benzoate 5% + Lufenuron 40% WG
35.	Ethion 40% + Cypermethrin 5% EC
36.	Ethiprole 40% + Imidacloprid 40% WG
37.	Fenazaquin10% + Bifenthrin 4% EC
38.	Fenobucarb 20%+ Buprofezin 5% SE

39.	Fipronil 40% + Imidacloprid 40% WG
40.	Fipronil 40% +Imidacloprid 40% WG
41.	Fipronil 5% + Buprofezin 20%
42.	Fipronil 7% +Hexythiazox 2% w/w SC
43.	Fipronil 4%+ Acetamiprid 4% w/w SC
44.	Fipronil 4% + Thiamethoxam 4% w/w SC
45.	Flubendiamide 19.92% +Thiacloprid 19.92% SC
46.	Flubendiamide 3.50% + Hexaconazole 5% WG
47.	Flubendiamide 4%+ Buprofezin 20% SC
48.	Flubendiamide 7.5% +Kresoxim methyl 37.5% SC
49.	Flubendiamide 8.33% + Deltamethrin 5.56% SC
50.	Hexythiazox 3.5+Diafenthiuron 42% WDG
51.	Imidacloprid 21% + Beta-cyfluthrin 10.5% SC
52.	Imidacloprid 6.0% +Lambdacyhalothrin 4.0% SL
53.	Indoxacarb 14.5% +Acetamiprid 7.7% SC
54.	Indoxacarb 5% +Fipronil 5% SC
55.	Isoprothiolane 28% + Fipronil 5% EC
56.	Novaluron 5.25% + Emamectin benzoate 0.9% w/w SC
57.	Novaluron 5.25% +Indoxacarb 4.5% SC
58.	Phenthoate 45% + Cypermethrin 6% EC
59.	Profenofos 40% + Cypermethrin 4% EC
60.	Profenofos 40% +Fenpyroximate 2.50% EC
61.	Propargite 42% + Hexythiazox 2% EC
62.	Propargite 50%+ Bifenthrin 5% SE
63.	Pyriproxyfen 10% + Bifenthrin 10% EC
64.	Pyriproxyfen 5% + Fenpropathrin 15% EC
65.	Pyriproxyfen 5.0% + Diafenthiuron 25% SE
66.	Spirotetramat 11.01% + Imidacloprid 11.01% SC
67.	Thiamethoxam 12.6% + Lambda-cyhalothrin 9.5% ZC
B. Fungicides	
Sr.No.	**Formulations registered**
1.	Ametoctradin 27% +Dimethomorph 20.27% SC

2.	Azoxysrobin 120g/l + Tebuconazole 240 g/l SC
3.	Azoxystrobin 11.0% +Tebuconazole 18.3% SC
4.	Azoxystrobin 12.5% + Tebuconazole 12.5% SC
5.	Azoxystrobin 12.5% +Tebuconazole 12.5% SC
6.	Azoxystrobin 18.2% + Cyproconazole 7.3% SC
7.	Azoxystrobin 18.2% +Difenoconazole 11.4% SC
8.	Azoxystrobin 4.8% + Chlorothalonil 40.0% SC
9.	Azoxystrobin 7.1% + Propiconazole 11.9% SE
10.	Azoxystrobin 8.3% + Mancozeb 66.7% WG
11.	Azoxystrobin 11.5% +Mancozeb 30.0% WP
12.	Azoxystrobin 16.7% +Tricyclazole 33.3% SC
13.	Benalaxyl 8.0%+ Mancozeb65% WP
14.	Benalaxyl-M 4.0% + Mancozeb 65.0% WP
15.	Boscalid 25.2% + Pyraclostrobin 12.8% WG
16.	Captan 70% +Hexaconazole 5% WP
17.	Carbendazim 12% + Mancozeb 63% WP
18.	Carbendazim 12% + Mancozeb 63% WS
19.	Carbendazim 25%+ Flusilazole 12.5% SE
20.	Carbendazim 25% + Mancozeb 50% WS
21.	Carfentrazone Ethyl 20% +Sulfosulfuron 25% WG
22.	Chlorothalonil 40% + Difenconazole 4% w/w SC
23.	Copper Sulphate 47.15% +Mancozeb 30% WDG
24.	Cymoxanil 8% +Mancozeb 64% WP
25.	Dimethomorph 12%+ Pyraclostrobin 6.7% WG
26.	Famoxadone 16.6% + Cymoxanil 22.1% SC
27.	Fenamidone 10% + Mancozeb 50% WDG
28.	Fenamidone 4.44% + Fosetyl-Al 66.66% WDG
29.	Fluopicolide 5.56% + Propamocarb hydrochloride 55.6% SC
30.	Fluopyram 17.7% + Tebuconazole 17.7% SC
31.	Fluxapyroxad167 g/L+ Pyraclostrobin 333g/l SC
32.	Fluxapyroxad 250 g/l + Pyraclostrobin 250 g/l SC
33.	Fluxapyroxad 62.5 g/l + Epoxiconazole 62.5g/l EC
34.	Fluxapyroxad 75 g/l + Difenconazole 50 g/l SC

35.	Hexaconazole 4%+ Carbendazim16% w/w SC
36.	Hexaconazole 4% +Zineb 68% WP
37.	Hexaconazole 5% + Validamycin 2.5% SC
38.	Improvalicarb 5.5% +Propineb 61.25% WP
39.	Iprodion 25% + Carbendazim 25% WP
40.	Kasugamycin 5% +Copper Oxychloride 45% WP
41.	Kresoxim methyl 15% + chlorothalonil 56% WG
42.	Kresoxim methyl 18% + Mancozeb 54% w/w WP
43.	Kresoxim methyl 40% + Hexaconazole 8% w/w WG
44.	Mancozeb 40% +Azoxytrobin7.0% w/w OS
45.	Mancozeb 50%+ Thiophanate methyl 25% WG
46.	Mandipropamid 5.0% +Mancozeb 60.0% WG
47.	Metalaxylï M 3.3% + Chlorothalonil 33.1% SC
48.	Metalaxyl-M 8%+ Mancozeb 64% WP
49.	Metalaxyl-M 4% + Mancozeb 64% WP
50.	Metiram 44% + Dimethomorph 9% WG
51.	Metiram 55% + Pyraclostrobin 5% WG
52.	Picoxystrobin 6.78%+ Tricyclazole 20.33% SC
53.	Picoxystrobin 7.05% +Propiconazole 11.7% SC
54.	Prochloraz 24.4% + Tebuconazole 12.1% EW
55.	Prochloraz 34.8% + Propiconazole 7.8% EC
56.	Prochloraz 5.7% + Tebuconazole 1.4% ES
57.	Prochloraz 23.5% +Tricyclazole 20% SE
58.	Propiconazole 10.7% + Tricyclazole 34.2% SE
59.	Propiconazole 13.9% + Difenoconazole 13.9% EC
60.	Propineb 54.2%+ Tricyclazole 15.0% WP
61.	Pyroclostrobin 133g/l + Epoxiconazole 50g/l (w/v) SE
62.	Streptomycin + Tetracycline (90+10)
63.	Tebuconazole 10% + Sulphur 65% WG
64.	Tebuconazole 15% + Zineb 57%W DG
65.	Tebuconazole 50% + Trifloxystrobin 25% WG
66.	Tebuconazole 6.7% + Captan 26.9% SC
67.	Triafamone 20% + Ethoxysulfuron 10% WG

68.	Tricyclazole 18% + Mancozeb 62% WP
69.	Tricyclazole18.0 + Tebuconazole 14.4% SC
70.	Tricyclazole 20.4%+ Azoxystrobin 6.8% SC
71.	Tricyclazole 45% + Hexaconazole 10% WG
72.	Flubendiamide 3.5% + Hexaconazole 5% WG

Annexure-2

Standard Operating Procedure (SOP) for use of

Drone Application

with Pesticides for Crop Protection
and for Spraying Soil & Crop Nutrients in Agricultural,
Forestry, Non-Cropped Areas, etc.

सत्यमेव जयते

Government of India
Ministry of Agriculture and Farmers Welfare
Department of Agriculture and Farmers Welfare
Krishi Bhawan, New Delhi

Standard Operating Procedure (SOP) for use of

Drone Application

with Pesticides for Crop Protection
and for Spraying Soil & Crop Nutrients in Agricultural,
Forestry, Non-Cropped Areas, etc.

सत्यमेव जयते

Government of India
Ministry of Agriculture and Farmers Welfare
Department of Agriculture and Farmers Welfare
Krishi Bhawan, New Delhi

Narendra Singh Tomar
Minister of Agriculture & Farmers Welfare
Government of India
Krishi Bhawan, New Delhi

सत्यमेव जयते

MESSAGE

Drones have found their place in private industrial use for many years but their commercial applications are growing at a faster pace now as inventors are coming up with new ideas with major focus on Indian agriculture. The drones are being considered as an essential tool for farmers for various applications now like providing easier ways to monitor small sections of crops and entire fields remotely and also address multiple challenges in the agriculture sector.

The influence of technology in the Indian agricultural sector has been invariably positive since its commencement and the present Government has recognized the importance of technology for achieving food security and addressing the issues and consequences of environmental degradation, pollution and water scarcity etc.

I am confident that the introduction of drone technology in Indian agriculture will be a phenomenal innovation with potential to transform the way the routine manual activities are carried out in agriculture. It will definitely help in optimizing the inputs and reduce the wastage besides boosting crop yields and minimizing time and expenses.

I am happy to note that the Ministry of Agriculture & Farmers Welfare in consultation with all the stakeholders of this sector, has brought out Standard Operating Procedures (SOPs) for use of drones in pesticide and nutrient application that provides concise instructions for effective and safe operations of drones. I am sure that the present publication will be of immense benefit to all the stakeholders involved in use and promotion of drone technologies in Indian agriculture.

(Narendra Singh Tomar)

Kailash Choudhary
Minister of State for Agriculture
& Farmers Welfare
Government of India

सत्यमेव जयते

MESSAGE

It gives me pleasure to note that the Ministry of Agriculture and Farmers Welfare, has taken some initiatives to encourage and promote the use of Drones Technology in agriculture Sector that has great potential to transform Indian agriculture by helping farmers to manage their fields and resources in a better and more sustainable way. The SOPs/ Guidelines will certainly, motivate the farmers for quicker adoption of the technology in application of Pesticides and other agrochemicals.

In line with the Government of India commitment, to double its farmer incomes, there is an immediate need for the agricultural sector to adopt leading-edge digital and precision agriculture technologies to improve farm productivity. Drone is one such most precise and effective technology that has the potential to revolutionize the farming sector through need-based precise and focused application of crop inputs that will directly enhance the input use efficiency and farmer safety whilst simultaneously lowering the overall costs and increasing income of the farmers.

I congratulate and extend my good wishes to all the officers from concerned Divisions of DA&FW, Ministry of Civil Aviation, Scientists from ICAR, executives from industries viz drones, pesticides, fertilizers etc; for providing their valuable inputs for bringing out this SOPs/ Guidelines that would Guide the farmers, operators, Custom Hiring Centers, policy makers, extension workers, etc about the various technical, safety, training, Rules/ regulatory requirements for using Drones for application of pesticides and soil crop nutrients & other agro-chemicals.

(Kailash Choudhary)

Shobha Karandlaje
Minister of State for Agriculture
& Farmers Welfare
Government of India

सत्यमेव जयते

MESSAGE

The adoption of modern technologies in agriculture, such as the use of drones or Unmanned Aerial Vehicles (UAVs) have great potential to revolutionize the Indian agriculture and ensure country's food security.

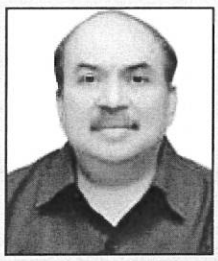
The farmers face many problems like unavailability or high cost of labours, health problems by coming in contact with chemicals (fertilizers, pesticides, etc.) while applying them in the field, bite by insects or animals, etc. In this context, drones can help farmers in avoiding these troubles in conjunction with the benefits of being a green technology. Drones are nowadays emerging as a component of precision agriculture along with contributing to sustainable development of agriculture. Use of drones in agriculture also have ample opportunities to provide employment to people in rural areas.

Keeping in view that the use of drones has a plethora of advantages, the government has eased out the restrictions for drone usage in the country and is supporting startups to come up with novel ideas. It gives me immense pleasure that the Ministry of Agriculture and Farmers Welfare (Department of Agriculture & Farmers Welfare) after lot of deliberation with all the stakeholders of drone sector, has brought out a publication on Standard Operating Procedures (SOPs) for use of drones in pesticide and nutrient application that provides guidelines and instructions for effective and efficient use of drones while ensuring safety of operations. I extend my best wishes to the contributors of this publication and hope that the publication will be a great help in promoting drone technologies in Indian agriculture.

(Shobha Karandlaje)

Sanjay Agarwal
Secretary
Government of India
Minister of Agriculture & Farmers Welfare
Department of Agriculture & Farmers Welfare

सत्यमेव जयते



FOREWORD

Pesticides are one of the important agri-inputs to address protection of crops against a large number of pests that can wash away entire investment of farmers and hence they act as an essential input that yields substantial returns to the farmers.

Conventional methods of pesticide spray application lead to excessive application of chemicals, lower spray uniformity, unnecessary deposition and non-uniform coverage; resulting in excessive usage, water & soil pollution as well as higher expenditure on pesticides. With conventional manual sprayers, the safety of operators is also a major concern.

The use of drone technology as a modern farming technique is aimed at making production more efficient through precise spraying of pesticides and crop nutrients. This approach would not only ensure accuracy, uniformity in spray across the field, reduction in the overall use of chemicals within the area, but will also take care of the safety of the operators. The manned workload can be limited even further by aerial mapping feature of the drones thus helping farmers in surveillance and monitoring of their crops and in identifying presence of pests, soil condition or any crop damage.

I appreciate the team efforts made by the concerned officers of Mechanization and Technology (M&T) and Plant Protection (PP) Divisions of the Ministry of Agriculture & Farmers Welfare, in collaboration with various stakeholders, to bring out the publication on Standard Operating Procedures (SOP) for use of drones in application of pesticides and crop/soil nutrients.

I hope that this SOP on use of drones in application of pesticides and crop/soil nutrients would support and facilitate increase in income of farmers with safer and efficient use of inputs as well as help users by providing them with guidelines for safe and controlled use of drone during spraying operations.

Sanjay

(Sanjay Agarwal)

Dr. Abhilaksh Likhi, IAS
Additional Secretary
Government of India
Minister of Agriculture & Farmers Welfare
Department of Agriculture & Farmers Welfare

सत्यमेव जयते

MESSAGE

Drone is a critical technology that will help to drive the agricultural sector to new heights. There are several agricultural activities like spraying of pesticides as well as soil and crop nutrients, monitoring and analysis of field moisture, fertigation, planting, harvesting etc., which can be performed through drones. This emerging technology can help the farmers in optimizing both the productivity and profitability of their land by reducing time, increasing the efficiencies of the inputs and securing high yield and quality of their crops. The use of drones also enable to minimize the risk of health and environmental hazards associated with manual spraying of pesticides and other agrochemicals.

The use of drones in the agricultural sector is only expected to rise as the agribusiness industry matures and so it is good to know how to use this technology judiciously. Though the technology is still emerging in India, many organizations are trying it for the benefits of Indian farmers.

The Ministry of Agriculture & Farmers Welfare has acknowledged the importance of drones in the Agriculture Sector. In context of promoting the use of drones for providing various services in Agriculture, the Ministry has brought out "Standard Operating Procedure" (SOP) for application of drones for pesticides as well as nutrient spraying. This will enable knowledge sharing among the farmers and other stake holders for effective, safe and judicious use of this technology.

I extend my sincere gratitude to all the stakeholders for providing the necessary inputs for publication.

(Abhilaksh Likhi)

Shomita Biswas
Joint Secretary
Government of India
Minister of Agriculture & Farmers Welfare
Department of Agriculture & Farmers Welfare

सत्यमेव जयते

ACKNOWLEDGEMENT

Precision agriculture practices, which can help farmers make better informed decisions, have evolved significantly over recent years and drones, also known as unmanned aerial vehicles (UAVs), are expected to play an increasingly important role in precision farming.

Keeping in view that the use of drones has a plethora of advantages, the government has eased out the restrictions for drone usage in the country and is supporting startups to come up with novel ideas. It gives me immense pleasure that the Ministry of Agriculture and Farmers Welfare (Department of Agriculture & Farmers Welfare) has brought out a publication on Standard Operating Procedures (SOPs) for use of drones in pesticide and nutrient application that provides guidelines and instructions for effective and efficient use of drones while ensuring safety of operations.

I am extremely grateful to Shri Sanjay Agarwal, Secretary, Department of Agriculture & Farmers Welfare, for his constant support, guidance, directions and active participation in bringing out this publication.

These SOPs are the outcome of several meetings and discussions with various stakeholders across various Ministries, academic institutions, organizations, regulators, experts and the industry. I am thankful to all the committee members for their suggestion, support and active participation in the proceedings of the committee.

I wish to express my thanks and gratitude to all others who have directly or indirectly contributed in various forms which has helped in bringing out this publication.

(Shomita Biswas)

CONTENTS

Section-A
(SOPs for applying pesticides using drones)

Section-B
(SOPs for spraying soil & crop nutrients using drones)

SECTION-A

Standard Operating Procedure (SOP) for applying Pesticides for Crop Protection by Using Drones in Agricultural, Forestry and Non-Cropped Area etc.

1. Objectives:

Indian Agriculture has gone through rapid advancements and has benefited from research and adoption of new technologies by farmers. Technologies like drip irrigation, mechanized farming for planting, harvesting and grading are being successfully used for sustainable agriculture in India.

In recent years, use of drone in agriculture has gained prominence and some states are actively engaged in checking the suitability of this new technology in Indian agriculture. Application of pesticides using drones has a great potential as we move towards commercialization and achieving precision in agricultural crops.

Drones are going to be important for increasing efficiency of application of crop protection chemicals by reducing manpower requirement, reducing time of application, reducing volume of water, quantity of chemicals and saving drift to environment along with reducing exposure to human being to hazardous chemicals.

In conventional agricultural practices, pesticides are sprayed either manually or with the help of tractor-mounted sprayers where high quantity of pesticides and water are used and where a sizable portion of spray goes waste in environment. However, drone-based spray requires less amount of water, as well as pesticides, due to better application and bio-efficiency.

To achieve the above stated objectives, Drones as a future technology for pesticide spraying, custom hiring and cooperative use will be encouraged and facilitated by Ministry of Agriculture and Farmers Welfare so that they are widely available and easily accessible to the farmers of the country. Drone as future technology for pesticide spraying are also expected to be linked with Agriculture insurance system for tackling any kind of damage and loss.

The SOP for drone regulation for pesticide application therefore covers important aspects like statutory provisions, flying permissions, area distance restrictions, weight classification, overcrowded areas restriction, drone registration, safety insurance, piloting certification, operation plan, air flight zones, weather conditions, SOPs for pre, post and during operation, emergency handling plan etc.

2. Statutory Provisions:

As per the provisions of the Insecticides Rules1971, Under the Insecticides Act, 1968 one of the functions of the board (Central Insecticides Board) constituted under section 4 of the Act, is to specify the uses of the classification of insecticides on the basis of their toxicity as well as their being suitable for aerial application [Rule 3 (b)].

Further, as per Insecticide Rules 1971, Chapter VIII Rule 43 on Aerial Spraying Operations, the aerial application of Insecticide shall be applicable for pesticide application through drones subject to the following provisions:

a. Marking of the area shall be the responsibility of the operators;

b. The operators shall use only approved insecticides and their formulations at approved concentration and height;

c. Washing decontamination and first-aid facilities shall be provided by the operators;

d. All aerial operations shall be notified to the public not less than twenty-four hours in advance through competent authorities (written intimation to be sent to the Executive Officer of the

respective Gram Panchayat &Panchayat Samiti, as well as the concerned Agriculture Officer of the area, at least 24 hours in advance).

e. Animals and persons not connected with the operations shall be prevented from entering such areas for a specific period; and

f. The pilots shall undergo specialization training including clinical effects of the insecticides (details on Pilot Training are given at point no.5.4 of this SOP).

3. The drone operations are being permitted by Ministry of Civil Aviation (MoCA) and Director General of Civil Aviation (DGCA) through the conditional exemption route. New drone directorates have been established in DGCA recently to speed up the approval process. They have published a detailed DGCA Requirements for Operation of Civil Remotely Piloted Aircraft System (RPAS) Guidance Manual with an objective to acquaint the public and the industry with the procedures being followed for processing all matter pertaining to issue of unique identification number, unmanned aircraft operator permit, and related activities. It will help to understand the flow of various processes involved and understand the intricacies of the system.

Further, Requirements for Operation of Civil Remotely Piloted Aircraft System (RPAS) mentions about the Civil Aviation Requirements (CAR) issued under the provisions of Rule 15A and Rule 133A of the Aircraft Rules, 1937 under the Aircraft Act, 1934 (22 of 1934) and lays down requirements for obtaining Unique Identification Number (UIN), Unmanned Aircraft Operator Permit (UAOP) and other operational requirements for civil Remotely Piloted Aircraft System (RPAS).These operations of drones are regulated by Unmanned Aircraft System (UAS) Rules, 2021, as published by Ministry of Civil Aviation vide G.S.R. 589(E) dated 25th August, 2021. Operators have the flexibility to utilize any RPAS/drone in case of agricultural pesticide spraying, irrespective of weight category or use case, provided the discharge of substance is cleared and mentioned in the Unmanned Aircraft Operator Permit (UAOP) issued by the DGCA.

4. **Details, precautions and pre-requisites etc. for drone based pesticide application**

The following details, precautions, prerequisites etc. shall be adhered to before, during and post-operation:

4.1. Pre-application:

i. Confirm not to fly in the drone-forbidden area (airport or electronic station). No prior permission is required for operating an unmanned aircraft system in a green zone.

ii. Ensure your Drone is Digital Sky Compliant with 'No Permission – No Take-off' hardware and firmware;

iii. Obtain Unique Identification Number (UIN) from DGCA for operating in controlled airspace and affix it on your drone.

iv. Obtain Unmanned Aircraft Operator Permit (UAOP), if applicable from DGCA for commercial operations and keep it handy

v. Ensure drone is in good condition (not damaged) and fit for flying safely.

vi. Keep an eye on interference: Interference can be from mobile devices or blockage of signals, do watch out when flying your drone.

vii. Fly in visual line of sight (VLOS): Always be within visual range of your drone.

viii. Ensure the operators are trained on both drone operation and safe use pesticide.

ix. No alcoholic drinks should be consumed within 8 hours preceding operation.

x. Calibrate drone spray system to ensure nozzle output and accurate application of labelled rates.

xi. Check if drone is in good condition and that there is no leak in the spraying system.

xii. Confirm a place for take-off, landing and tank mix operations.

xiii. Check and mark proposed treated area, boundary, the obstacles (walls, trees) around the field for safe operation.

xiv. Set up the least buffer zone (as specified by DGCA/ CIB&RC) between drone treatment and the non-target crop.

xv. Confirm presence of water sources - Do not spray pesticides near water sources (less than 100 m from target area) to avoid polluting water sources.

xvi. Check if the public has been notified/intimated at least twenty-four hours in advance through a written intimation to the competent authorities, that is the Executive Officer of the respective Gram Panchayat &Panchayat Samiti, as well as the concerned Agriculture Officer of the area.

xvii. Concerned territory in-charge/operators to ensure that animals and persons not connected with the operations shall be prevented from entering such areas for a specific period.

xviii. Do log your flights and intimate concerned authorities (like DGCA, local police etc.) of any incidents/accidents

xix. Don't fly drone over groups of people, public events, or stadiums full of people without permission

xx. Don't fly drone over government facilities/military bases or over/ near any no-drone zones.

xxi. Don't fly drone over private property unless permission is given.

xxii. Don't fly drone in controlled airspace near airports without filing flight plan or AAI/ADC permission (at least 24 hours before actual operation).

xxiii. Don't drop or carry hazardous material

xxiv. Don't fly drone from a moving vehicle, ship or aircraft.

xxv. Don't fly the Drone in contraventions to the Unmanned Aircraft System Rules (UAS), 2021 rules as published by Ministry of Civil Aviation vide G.S.R. 589(E) dated 25thAugust, 2021 and as amended from time to time.

4.2. During Application:

i. Read labels carefully to understand safety guidance.

ii. Wear Personal Protect Equipment (PPE).

iii. Do not eat, drink or smoke while spraying.

iv. Confirm the flying route was reasonable to minimize turn around.

v. Operation team shall always stay at the downwind end of the field and backlight direction.

vi. Spray with pure water first to test operation for at least 5 minutes wherever feasible and required.

vii. Ensure two-step dilutions to fully dissolve the pesticide.

viii. Adopt proper pressure for optimized droplet spectrum (>100μm).

ix. Check weather conditions for:

a. Appropriate Wind speed,

b. Appropriate Temperature,

c. Appropriate Humidity

x. Ensure appropriate flying height above target crop.

xi. Ensure appropriate water volume.

xii. Ensure appropriate flying speed.

xiii. Avoid having to walk through crop which has been contaminated by drifting spray.

xiv. Do not spray during active bee foraging period of the day. Avoid spray drift to flowering nectar crop.

xv. When spraying pesticides that are toxic to non-target organisms such as fish, birds and silkworm, strictly abide by the product label requirements and take effective measures to avoid risks.

xvi. Use anti-drift nozzle to decrease drift to human and environment.

4.3. Post Application:

i. Timely evacuation and transfer to fresh air.

ii. Triple rinse of empty container is mandatory.

iii. Ensure waste generated is kept to a minimum.

iv. The disposal of waste must conform to the local laws.

v. Never burn or bury hazardous waste.

vi. Never leave empty containers in the field. It should be disposed of as per the Insecticides Rule 1971.

vii. Set up warning signs in the spray area for reminding people.

viii. Take a shower and put on clean clothes.

ix. To prevent leakage of plant protection products in the process of transport and waiting to use.

x. Securely store plant protection products away from unauthorized people, animals and food when transporting and storing PPP. Safely dispose all spills immediately.

xi. Follow the maintenance schedule as prescribed by the Drone manufactures.

5. Critical parameters to be considered for Drone based pesticide application:

5.1. Drone related:

i. Only Director General of Civil Aviation (DGCA) certified/approved drone shall be permitted to carry-out agriculture spray. The reliability of the drone is assured through DGCA certification process.

ii. The drone must have capability to handle variable payload (depleting tank). The nozzle system should be attached in a manner that the spray swath is continuous when sprayed from the minimum permitted height above the uniformly distributed crop (e.g. paddy/sugarcane).

iii. The drone must be fitted with accurate altitude sensor to ensure desired height above the crop is maintained throughout the spraying mission.

iv. The GPS accuracy of the drone and accuracy of the map shall be characterized and the same shall be utilized to define the safety/buffer margin while creating the geo-fencing around the field or obstacles.

v. The drone spray system must support variable flow control to ensure uniform dispensing of the payload.

vi. The drone must have necessary fail-safes including Return to Home (RTH) on empty tank and auto mission restart from the point RTH was engaged.

vii. The drone spray system should be leak proof and dripping of Pesticides/Insecticides should be avoided during the application. (Check before flight)

5.2. Pesticides/Insecticides

i. Only Central Insecticides Board and Registration Committee (CIB&RC) approved Pesticides/Insecticides shall be used.

ii. The dose has to remain within the range approved by CIB&RC.

iii. The Pesticides/Insecticides (liquid/solid) compatibility with the drone spray system shall be established prior to the mission for the desired dilution. This is to ensure Pesticides/Insecticides solubility formulation stability and ability to spray with the type of nozzles provided in the drone. In case of mixing of more than one Pesticides/Insecticides, CIB&RC specified guidelines must be adhered to.

iv. The minimum dilution shall be decided based on the fulfilment of the above-mentioned requirements and ensuring satisfactory coverage of sprayed input both horizontally and vertically.

v. Pesticides/Insecticides should be diluted only with clean water wherever applicable or with other suitable ingredient as has been approved by the CIB&RC.

5.3. Environment Limitations

The drone based spray that may be permitted under the conducive weather conditions to get the best results in terms of appropriate Wind speed, Temperature& Relative Humidity etc.

5.4. Pilot Training

i. Only DGCA certified pilots shall be permitted to fly the agri drones.

ii. A training module as devised by NIPHM, Hyderabad encompassing pesticide/ insecticide handling, agri-mission specific operational protocols, and relevant crop protection guidelines shall be made mandatory for pilots operating pesticide/ insecticide spray drones.

5.5. Drift Management -Critical Operational Parameters

Majority of land holdings are small and there are possibilities of spray drift to the nearby crop fields while spraying with drones. To minimize the spray drift, apart from wind limitation, the following are important and to be suitably adopted:

i. Spray height above crop canopy

ii. Speed of the drone

iii. Suitable nozzles and droplet size

iv. A buffer zone can be demarcated (geo fenced)

v. Spray schedule should be at appropriate time gap either before rainfall or after rainfall.

vi. Others, as specified in guidelines issued by CIB&RC from time to time.

5.6. Safe guarding the non-targets

The non-targets shall be safe guarded by adhering to the following operational protocols:

i. Buffer zone as per CIB&RC approved guidelines to cater to Pesticides/Insecticides drift, shall be maintained between the adjacent farms or different crops to avoid spray on non-targets.

ii. During the spray operation, operator should always maintain the distance approved by CIB&RC from the drone and avoid windward direction as much as possible.

iii. No human or animal movement shall be permitted within the farm during and immediately after the spray operations.

iv. Drone based pesticides spray operations should be conducted at a distance approved by CIB&RC from water bodies, residential areas, fodder crops, public utilities, dairy, poultry etc. and as per DGCA guidelines.

6. Registration requirements of pesticides for drone application:

The Registration requirements of pesticides for drone application and the modalities are dynamic in nature and will be considered based upon the safety, efficacy, statutory and legal requirements and published by the Central Insecticides Board and Registration committee (CIB&RC) from time to time. Drone users shall use only Central Insecticides Board and Registration Committee approved pesticides.

For registration of insecticides/pesticides and for use with drone, the applicant shall apply before Secretariat of CIB&RC, in the manner, as prescribed by CIB&RC under the Insecticides Act, 1968.

7. Spray Monitoring Form & Data Submission:

Spray monitoring data duly filled by the operator/ service provider shall be submitted through email (as mentioned in the guidelines issued by CIB&RC)/online portal created for the purpose, with in seven days of application of pesticides through drone, in the form as prescribed in Annexure-I.

Annexure-I

SPRAY MONITORING FORM

1	**LOCATION of Trial Details**	1	2	3	4	5	6
1-1	Date						
1-2	Name of the location						
2	**VEGETATION DATA**						
2-1	Vegetation type (Crop, Grass, Bushes, Trees,)	G B T C	G B T C	G B T C	G B T C	G B T C	G B T C
2-2	Height from ground/ Crop Canopy (m)						
2-3	Crop names and pest/disease/ weed infection/infestation/ intensity (%)						
3	**PESTICIDE DATA**						
3-1	Trade name & Common name						
3-2	Concentration (g a.i./l or %)						
3-3	Formulation (EC, ULV, Dust)	E U D	E U D	E U D	E U D	E U D	E U D
3-4	Expiry date						
3-5	Is the insecticide mixed with water or solvent?	Y N	Y N	Y N	Y N	Y N	Y N
3-6	If yes, what solvent and mixing ratio						
4	**WEATHER CONDITIONS**						
	Start and end of control operations	Start End	Start End	Start End	Start End	Start End	Start End
4-1	Date & time						
4-2	Temperature (°C)						
4-3	Relative humidity (%)						
4-4	Wind speed (m/s)						
4-5	Wind direction (degrees from N)						
4-6	Spray direction (degrees from N)						
5	**SPRAY APPLICATION**						
5-1	Sprayer type (Rotary, Air blast, ENS, Hydraulic, Other)	R A E H O	R A E H O	R A E H O	R A E H O	R A E H O	R A E H O
5-2	Sprayer operator (Pilot, Driver, Hired, Other)	P D L H O	P D L H O	P D L H O	P D L H O	P D L H O	P D L H O
5-3	Sprayer manufacturer						
5-4	Sprayer model						
5-5	Sprayer platform (Aerial, Vehicle, Handheld)	A V H	A V H	A V H	A V H	A V H	A V H

5-6	Date of last calibration						
5-7	Atomizer height above ground (m)						
5-8	ROTARY SPRAYERS: speed setting (blade angle, pulley setting, no. batteries)						
5-9	Speed of atomizer (rpm)						
5-10	Flow rate setting (which nozzle or restrictor used)						
5-11	Flow rate/atomizer (l/min)						
5-12	Number of atomizers						
5-13	Track spacing (m)						
5-14	BARRIERS ONLY: width and spacing (m)						
5-15	Forward speed (km/h)						
5-16	AERIAL SPRAYING: support supplied	GP = ground party available RC = radio communication with aircraft TG = DGPS track guidance GP RC TG	GP RC TG	GP RC TG	GP RC TG	GP RC TG	GP RC TG
5-17	Ground marking (GPS, Flag, Mirror, Smoke, Vehicle, None)	G F M S V N	G F M S V N	G F M S V N	G F M S V N	G F M S V N	G F M S V N
6	**CONTROL EFFICACY**						
6-1	Effectiveness/mortality (%)						
6-2	Days after treatment/ time after treatment (hours)						
6-3	Yield of Crop/method of Effectiveness /mortality estimation (Quadrats, Target size, Visual, Cages, Other)	Q T V C O	Q T V C O	Q T V C O	Q T V C O	Q T V C O	Q T V C O
7	**SAFETY AND ENVIRONMENT**						
7-1	Protective clothing: what did the operator wear?	G = goggles M = mask L = gloves O = overalls B = boots G M L O B	G M L O B	G M L O B	G M L O B	G M L O B	G M L O B
7-2	Was soap and water available?	Y N	Y N	Y N	Y N	Y N	Y N
7-3	Who was informed of spraying? (Farmers, Nomads, Villagers, Officials, Beekeeper, others, etc.)	F N V O B	F N V O B	F N V O B	F N V O B	F N V O B	F N V O B
7-4	Effect on non-target organisms	Y N	Y N	Y N	Y N	Y N	Y N
7-5	If yes, what type of effect?						
7-6	Details of anyone who felt unwell or if other problems were encountered						
7-7	Details about nearby water-bodies and water channels						

SECTION-B

Standard Operating Procedure (SOP) for spraying Soil & Crop Nutrients by Using Drones in Agricultural, Forestry and Non-Cropped Area etc.

INTRODUCTION

The necessity of increasing food production to meet the demand of the ever-increasing population in India needs no emphasis. In 2017-18, total food grain production was about 275 million tons (MT). India is the largest producer (25% of global production), consumer (27% of world consumption) and importer (14%) of pulses in the world. Estimates suggest that at the current level of production, an additional 5 Mt food grain has to be added each year to the national food basket for the next decade to feed the increasing population. The total area under cultivation is constant over the past several decades. Maintenance of native soil fertility in the intensively cultivated regions of the country is one of the preconditions of maintaining and improving the current crop yield levels. Intensive cropping systems remove substantial quantities of crop nutrients from soil during continuous agricultural production round the year. The maintenance of soil nutrient is important to get higher productivity as well as production. The soil and crop nutrients are supplied to plants through soil, foliar and fertigation methods. The application of the fertilizer using conventional methods has limitations and challenges of labour shortage, energy, un-timeliness and low input use efficiency. Moreover, the conventional machines used for crop nutrient spraying are heavy and may compact the soil along with mechanical damage to crop.

Unmanned Aerial Vehicles (UAVs) which is usually known as drones can be a vital alternative to overcome these challenges. Drones can be used for targeted input application, timely diagnosis of nutrient deficiency, crop health monitoring, rapid assessment of crop yield and crop losses. Crop nutrient spraying through drones facilitates rapid application and can be used to treat large areas quickly. The drones have capability to fly at low height (1m -3 m) over the crop canopy. This makes them suitable for spraying crop nutrient and is more adoptable compared to aerial spray. The soil and crop nutrient application using drone also saves input cost and environment.

Drone is part of precision agriculture wherein GPS technology is used for navigation with precision and Google maps are used for spray mission planning for uniform spray of crop nutrients. Spraying through drones is beneficial for farmers for optimal usage of agriculture inputs, saving of effort and time and dependencies on labor. Drones can cover up to 30 acres of spray per day using multiple batteries. Drone avoids exposure of farmers to harmful chemicals while spraying. Drone spraying of crop nutrients is also helpful for tall crops like sugarcane, bushy crops like cotton and fields like Paddy. Drone is also helpful for spraying of crop nutrients in hilly regions wherein it is difficult for other farm equipment to reach.

Many startups, industries, SAUs and research institutions have started working on drone to harvest its potential in agriculture including soil and crop nutrient spraying. As the DGCA guidelines are available now, many companies have registered their products on Digital Sky Platform including agriculture drone. The drones are available in different designs and payloads however the drones of payload capacity 1 kg to 25 kg are more common. The research is being conducted on different aspects of agricultural drones including payload, crop damage, battery limitation, ease of use and handling, affordability to farmers and legal compliances issues. From the initial trials, it has been found that drones of about 10 kg payload is suitable for crop nutrient spraying at the height of 1 m to 3 m over the crop canopy with minimum crop damage and for effective combing action along with low battery consumption. The drones of payload capacity of 10 kg are also relatively low cost, less voluminous, low operating cost, easy to transport, less chances of instability and accidents. In addition, drones of these payload capacities do not require Air Traffic Control (ATC) clearance before flying.

As the drones are being increasingly used for several agricultural operations, it is essential to develop SOPs that would facilitate application of different types of soil and crop nutrients using drones; and harness their potential for successful adoption of soil and crop nutrient spraying.

The Department of Agriculture & Farmers Welfare (DA&FW) –ICAR Interface was held on 18.04.2019 and a decision was taken to study the use of drones and recommend standard guidelines for operation of drone for pesticide application. In pursuance of that decision, a committee of six expert members of the concerned area was constituted under Chairmanship of Dr. K Alagusundaram, DDG (Agril. Engg.), ICAR by DA&FW (M&T Division), Ministry of Agriculture & Farmers Welfare, Government of India vide letter No. 13-8-2017-M&T(I&P) dated 27.05.2019) to formulate the standard guidelines for operation of drones for pesticide application. The draft document on guidelines & policy issues, submitted by the committee, was presented and discussed with DAC&FW. Keeping in view of the optimal utilization of drones & its economic feasibility for use in agriculture sector, it was suggested/advised to explore the drone enabled technologies for different activities of cultivation like; application of soil & crop nutrients, irrigation, health monitoring of crop health etc. Accordingly, it was decided to frame SOPs for use of drones in application of pesticides, soil & crop nutrients. Accordingly, two sub committees were constituted vide letter No. 13-8/2017-M&T(I&P) dated 27.05.2019 to formulate the standard guidelines for operations (SOPs) of drones; one for pesticide application and second for application of soil & crop nutrients.

In view of the above, a committee was constituted to explore the possibilities of using drone technology for soil and crop nutrient application and draft the Standard Operational Guidelines. The details of the committee members are provided in Annexure-III.

1. Use of UAV (Drones) in soil and crop nutrient context

Soil and crop nutrient

The soil nutrient application based on assessment of soil nutrient status is a method of precision agriculture, a futuristic technology and is in the research and development phase. However, the committee considers that the UAVs (drones) have great potential for soil nutrient management; and use of drones in assessment and application of soil nutrient has potential in precision agriculture enabling saving of the precious resources, minimizing the environmental hazards, saving in labour costs and enhancing crop, land and economic productivity.

An agricultural drone is used to help optimize agriculture operations, increase crop production, and monitor crop growth by **assessing and mapping** different nutrients and efficient spraying of soil / crop nutrients.

A. Nutrient assessment / mapping

- Soil nutrient mapping can be helpful for real-time site-specific nutrients management.
- Traditional methods of soil nutrient analysis give properties of the soil at sampled locations only, whereas use of UAV provides the properties of the entire field in short time.
- As use of UAV based soil nutrient analysis requires less time and is energy efficient, the application of deficient nutrient can be done on time and with precision to improve the yield significantly, saving of fertilizers and reducing soil pollution.
- Drones fly over the field and take high resolution pictures which can be directly sent to the cloud /

software facilitating precise corrective measures in the form of prescription maps.

- The maps can then be uploaded on the farm equipment which will precisely regulate delivery of inputs (fertilizers) that would need to be applied in the field for crop growth.

B. Spraying of soil / crop nutrients

The following aspects need to be considered when using drones for the application of soil / crop nutrients:

- Form / concentration of the nutrient being sprayed / broadcasted
- Sensors / spraying systems installed on the drone
- Both forms of essential soil / crop nutrient i.e. solid forms like powder, crystals, prills, granules, super-granules, briquettes, etc. and liquid forms like water soluble powders, liquid nutrients, nano-fertilizers, growth regulators, etc. whether organic or inorganic can be sprayed using drones
- At least 10 times more area can be sprayed per day per drone as compared to the traditional knapsack sprayers
- 80-90% of water can be saved in comparison to traditional spraying methods (depending on the sprayer system of the drone)
- Different kinds of sprayer nozzles are available depending on the form and concentration of the nutrients to be applied.

C. Drone, sensors, data processing software and soil nutrient spraying system

- Drones can significantly alleviate labour pressure on agricultural operations like applying fertilizers, while enhancing the crop coverage area per day. This will provide significant ease of farming, who can use the time saved to carry out other activities, while responding quickly to biotic challenges.
- There will be three arrangements for drones with sensors i.e.,

  (a) Drone with multispectral camera

  (b) Drone with fertilizer spraying system for granules/liquid and

  (c) Drone with multispectral camera and spraying system for granules/liquid.
- Three types of soil nutrient delivery protocols are possible:

  (1) Recommended dose of fertilizer (RDF) based protocol (liquid/solid),

  (2) Two-step operation protocol and

  (3) Real-time operation protocol
- The **RDF based protocol** of nutrient application is done based on the recommendations at each crop stage as well as soil nutrient requirement. The RDF based application protocols can be immediately deployed for liquid and granular nutrients (Macro, Micro and Nano-Micro (or) Macro fertilizers). The two-step operation can be standardized in near future and or real-time operation needs lot of research and development for standardization as a futuristic technology development.

- Initially, agricultural drone R&D institutions and manufacturers may be allowed to follow the (1) RDF based protocol and (2) two-step operation protocol
- **Two-step process:** In the ***first step***, the soil imaging of the field is done to assess the soil nutrient status and post-process the data to generate the GPS tagged precision nutrient requirements (quantities) map of the field as an input logic to the nutrient dispensing/spraying drone with the help of soil indices. The indices may indicate the level of different nutrients (primary, secondary and micro) in the field. The software may also calculate the amount (primary, secondary and micro) to be applied for a particular selected crop depending on the crop stage. This data can also be useful for agricultural machines to spray the soil nutrient in a variable rate.
- In the ***second step***, a drone with a fertilizer spraying/dispenser system may be used to apply the fertilizer by controlling the fertilizer metering unit to achieve the variable rate application.
- **In real-time operation protocol,** the imaging and spraying/dispensing of nutrients is placed on drone and imaging, live processing and delivery should happen simultaneously in real-time. For real-time operation, the drone should be equipped with a powerful live-processing hardware and software. The device should be able to process the multispectral camera data without lag. Therefore, there is a need to do more research so that it can be practically feasible.
- However, cost economics for these methods should be studied at different locations and crops.
- There is a strong need to research on liquid fertilizer application methods considering the security majors since pesticide spraying may be tried by the farmers/drone service providers using the same setup.
- The manufacturing standards for an agriculture drone should be followed by the industry as per the Dr. Alagusundaram committee's report and DGCA guidelines.
- While it will be possible to use drones to know the soil nutrient levels, developing the data base shall be a time consuming affair. Hence, it is would be appropriate to start with the foliar application of nutrients.
- Drone with suitable camera like Multispectral (Coarse bands) and Hyper spectral (Fine bands) can be used for soil analysis using Geo and Time tagged images. After software post processing, AI and ML algorithms can be used to develop models for soil analysis and to identify the issues.
- Before sowing or planting, the camera sensors like multispectral, hyper-spectral can be used to capture the data of soil fertility. However, LiDAR sensor may be used to capture the data in dense canopy crop.
- The foliar application of the micronutrient using drone should be as close as possible on the crop canopy. The electrostatic nozzle may be used to avoid the drift during operation.

2. Feasibility of sustainable adoption of drone

- Drones are being available at affordable prices and are capable of imaging ground data with corresponding geographic locations. This helps the user to have a complete and clearer picture of the ground information.
- Unmanned Aerial Vehicles (UAVs) are autonomous drones that can be programmed to operate as per a defined plan which helps for data collection with precision and delivery of inputs.

- Drones provide a quick image of a field in a fraction of the time and cover maximum land in a single flight; and hence have the capability of synoptic view/assessment.
- Drone industry is rapidly increasing in India in several sectors, with no exception to agriculture. Hence, any drone based technology can be adopted on sustainable basis including application of soil nutrients.
- It has been noticed that the micronutrient powder application on the cabbage crop can be done with 8-10 litre water to minimize the phyto-toxicity. Similarly, the experiments have to be conducted for different crops to know the effects of different concentration level of micronutrients on the crop. The foliar application of micronutrient on leafy vegetable/crop using drone is more suitable. Drones can be used for spraying nutrients after diluting in water (10 litres) and can also be used to broadcast the fine granules up to 10 kg per acre. Drone being an aerial robot used for spraying and broadcasting of plant nutrients is part of precision agriculture as Mission Planner Software uses Google Maps for flight planning and Satellite based GPS used for very precise drone navigation.
- Bio liquid fertilizers can be allowed to spray on the different crops using drone. However, the chemical liquid fertilizers' formulation has to be checked through experimentation.
- Application of nutrient or urea in foliar form uniformly can be started directly without waiting for R&D to be conducted for variable mapping of nutrient.
- For variable application, real time mapping of nutrients in crops can be done measuring NDVI or other suitable VIs of crops for prediction of nutrient deficiency and apply nutrient in foliar form.
- For foliar application, spraying system may be fitted with rotary atomization nozzles to reduce the drift.
- Based on crop health profiling using drones and overlaying other data, crop nutrient profiling can be done. AI controlled automatic flight path generation will ensure that the drone flies over the nutrient deficient areas and uses the shortest path. AI driven pumps would spray nutrients only as per deficiency and on exact location. Thus greater amount of spray over regions with greater deficiency would be ensured and not the uniform spray over the entire land parcel irrespective of the nutrient deficiency.
- This is a disruptive technology and farmers may not adopt it unless they are given ownership of its implementation and their traditional inputs are not factored in. So the model should rely on using this technology with inputs from farmers as well.
- Foliar application is possibly the best way forward – foliar application especially in plantation crops such as coffee, hilly terrain crops such as apples and flat land crop such as sugarcane will help improve productivity as well as quality as nutrients can be delivered round the year.
- The rate of flow and amount of soil nutrients to be sprayed through each nozzle is configurable and can be fine controlled electronically through the knob on Ground Control Station (GCS). Different type of nozzles (Centrifugal, Electrostatic, Atomizer, etc.) can be easily configured based on type of crop and nutrients to be sprayed. Hence this is an efficient and optimal usage of agriculture inputs for uniform spray of soil nutrients using drones.
- A drone of 10 kg payload capacity in normal conditions can cover 30 acres per day (6 hours/day)

with 5 sets of batteries.

- Cost of operation for different crops and agroclimatic conditions may vary from Rs. 350 to 450 per acre per operation of 6-10 min flight.

3. SOPs for use of drone assessment/ mapping of soil nutrients and application of nutrients in crops

A. Procedures/caution/precautions for storage of crop nutrients

For FPOs, Custom Hiring Centers and Service Provider

- Maintain a written inventory of all materials.
- Follow crop nutrient manufacturer's recommendation for storage.
- Do not store fertilizers in damp or dirty places. Make sure that bags of crop nutrients in the store do not absorb moisture from leaky roofs or water seepage through walls and floors.
- Store in a secured building to prevent unauthorized access.
- Properly label all materials.
- Keep crop nutrient materials away from the hazardous materials like herbicides, pesticides etc.
- Keep materials as far away as possible from doors or other places where spills could reach an outside area.
- Regularly inspect storage area for spills and leaks.
- Provide emergency eyewash and emergency drench showers within or near the storage area.
- Dispose of waste, excess or obsolete materials and chemicals in accordance with manufacturer's recommendation and in accordance with state law.
- Improper mixing and storage of fertilizers can result in large nutrient losses
- Provide absorbent spill kits in all liquid storage areas.

B. Procedures for use and application of crop nutrients

- FCO guidelines to be followed for use of all crop nutrients in agriculture.
- Crop nutrients should be applied by properly trained personnel
- **Good agricultural application practices should be followed: few points for examples**

i. Type and amount of crop nutrients to be used as per the recommendation of approved agencies or institutions.

ii. Dose and compatibility of the nutrients should be checked before spraying.

iii. Fertilize when the soil is wet (good agricultural practices provided separately)

iv. Never apply crop nutrients when heavy rain is anticipated.

v. Calibrate crop nutrient application (distribution, spraying, and broadcast) system regularly to ensure proper application and loading rates.

vi. Mix crop nutrients in clean application equipment under cover in an area where spills

will not come into contact with rainwater or storm-water runoff

vii. The excess use of crop and soil nutrients and mixing with pesticides may cause phytotoxicity. In this case, guidelines for pesticide application may be referred.

C. Procedures for application of solid (granules/powder) crop nutrient using drone

- Keep drone height in range of 1.0 to 3.0 m above crop canopy for each crop and each stage.
- Maintain the drone forward speed between 3-8 m/s.
- Appropriate dispensers like rotating disc type and pneumatic dispensers can be used for spraying of granular crop nutrients.
- In each flight, drone payload should not be more than 10 kg of granular/powder; crop nutrient can be dispensed at a forward drone speed of 3 -8 m/s.
- Rotational speed of disc preferably be in the range of 800 to 1000 rpm or as per user manual provide by the manufacturer.

D. Procedures for application of liquid crop nutrients using drone

- Liquid bio-fertilizers, organic (jivamrit, vermiwash, etc.), bio-decomposers, nano-fertilizers, liquid and soluble micro-nutrients and bio-stimulants existing formulations can be sprayed using drone as per recommendation of approved agencies or institution.
- Keep drone height in range of 1.0 to 2.0 m above crop canopy for each crop and each stage.
- In each flight, drone payload should not be more than 10 litre of liquid; crop nutrient can be dispensed at a forward speed between 3.0-6.0 m/s.
- Preferably keep nozzle beneath the motors to minimize the drift of the droplets.
- Restrict the spraying to the intended area.

E. Procedures for drone servicing/operation during application of Crop nutrients

- Stable and safe drone designs like hexacopter are recommended for the spraying of crop nutrient.
- Follow the user manual for calibration and maintenance of the drone before and after operations as recommended by the manufacturer.
- Follow DGCA guidelines and Dr. Alagusundaram Committee's recommendations for the operation of the **agricultural "Krishi"** drone.

F. Different standards and prerequisites for using drones to be followed to reduce drift and air pollution

The following prerequisites need to be followed before, during and post-operation

a) Before Application

- Drone assisted spraying system comprises of many sophisticated and sensitive components like real time kinematic global positioning system (RTK GPS), flight controller, remote control system, battery module, motor with propellers and spraying system. These components have to be checked for their soundness, safety and integrity before operating the drones in the field.

- The service provider and operator should have flying permissions and flying license from DGCA. In addition, the operator must have a training certificate on operation, repair and maintenance and safe use of soil and crop nutrient from ICAR/Govt. approved training centers. The operator should be healthy, of sound mind and steady during operation.
- The operator team may consist of preferably a team of three-four persons including a pilot, a co-pilot and one or two technicians for preparation of formulation and mixing and troubleshooting by addressing technical faults. However the technical team size is subject to scale and strength of operation of operator. The team members should be properly trained for their respective jobs and should have training certificate from recognized centers. Operator team should have office space with necessary facilities.
- The weather conditions like cloudiness, light intensity, temperature, wind velocity and direction should be recorded and decisions should be taken accordingly. Weather forecasting should also be considered before flying the drone. The drone should not be operated during cloudy and rainy conditions. It should be avoided immediately before and after the rains and also opposite to wind direction.
- The crop and field conditions and any obstacles near the field should be monitored. The home point of drone should be selected keeping in view the crop and field conditions. Flying path should be prepared according to field shape and required head space for turning. Safe distance (not less than 10 m) of nearby people from the drone take off place must be ensured. Operation team shall always stay at the downwind end of the field and backlight direction.
- Avoid flying of the drones near high-tension electrical towers to avoid signal interferences.
- There should be appropriate buffer zone between drone treatment and the non-target crop. Drone should be operated 100 m away from water bodies, residential areas, fodder crops, public utilities, dairy, poultry etc. during soil and crop nutrient application.
- The reach of soil and crop nutrient spray should be avoided during active bee foraging period of the day in flowering nectar crop. When spraying soil and crop nutrient that are toxic to non-target organisms such as fish, birds and silkworm, it should be strictly abided by the product label requirements and effective measures need to be taken to avoid risks.
- The drone and spraying unit should be properly calibrated before flying. The spraying unit should be checked for pump pressure, nozzle wear out for uniform spraying, and leakage in tank and lines. Proper pressure should be adopted for optimized droplet spectrum (100-150 μm). The soil and crop nutrient name and label should be checked before filling in the tank at recommended concentrations. The operator should use Personal Protect Equipment (PPE) throughout the operation.
- Always use clean water for preparing the solution of soil and crop nutrient. Containers and buckets used for mixing soil and crop nutrient should never be used for domestic purpose even after thorough washing.

- The service provider should carry additional spare parts like propellers, batteries (minimum four sets), motors and nozzles to the operational site.

b) During Application

- Monitor the behavior of drone continuously during operation to avoid accidents. The spraying system should also be monitored for not being choked during operation.
- Drone should be flown at a height of 1.0 to 3.0 m above the targeted crop canopy at a speed not exceeding 8 m/s during spraying.
- Discharged drone batteries should be replaced immediately.
- Never apply over-dose and higher concentration of crop nutrients than the recommended.
- Movement of human or animal should not be allowed in the operational field during spraying using drones.

c) Post Application

- After completion of spraying operation, the operator and the team should leave the operational site to receive fresh air, free of soil and crop nutrient residuals. Entry to the treated field immediately after operation should be avoided without wearing protective clothing. Warning sign at least for 2 hours may be put at the sprayed site to avoid hazards to humans.
- Left over spray solutions should be disposed-off at safer place like barren and isolated areas. Triple rinse of empty containers should be done. The disposal of waste must conform to the local laws. Hazardous wastes should never be burnt or buried. Empty containers should never be left in the field. Empty containers of crop nutrients should not be re-used for storing other articles.
- While transporting or storing PPPs (Plant Protection Products), the area should be beyond the reach of children, animals and unauthorized persons.
- Hands and face need to be washed with clean water and preferably with soap, immediately after the spraying operation. Also, the clothes must be changed. In case any sign of body contamination with hazardous or poisonous chemicals is perceived, consultation of doctor must be sought.
- After every 20 hours of flight, the drone should be inspected for the wear, loosen screws, scratches and distortion in propeller and frames.

Annexure- II

Details of the Expert Committee Members for Drafting of SOP for Applying Pesticides for Crop Protection by Using Drones

1.	Dr. Ravi Prakash, Plant Protection Adviser, CIB&RC, Faridabad	[Chairman]
2.	Dr. V.K. Singh, Director, ICAR-Central Research Institute for Dryland Agriculture, Santosh nagar, Hyderabad	[Member]
3.	Dr. Subhash Chander, Director, ICAR - National Centre for Integrated Pest Management, Pusa Campus, Pusa, Delhi.	[Member]
4.	Dr. V. K. Baranwal, Professor, Division of Pathology, IARI, New Delhi	[Member]
5.	Dr. Roaf A. Parray, Scientist, Agricultural Engineering, IARI, New Delhi	[Member]
6.	Dr. Manoj Kumar, Director, CPRI, Shimla, HP	[Member]
7.	Shri. C. R. Lohi, Deputy Commissioner (M&T), DA&FW	[Convener]

Technical Experts from Government Organization

1. Shri. Y. Raghunadha Babu, Chairman, Tobacco Board, Ministry of Commerce and Industry, Department of Commerce, G.T. Road, Guntur, (A.P)
2. Dr. Brijesh Tripathi, DD (Chem.), CIB&RC, DPPQ&S, Faridabad
3. Dr. K.L. Gurjar, DD(PP), CIB&RC, DPPQ&S, Faridabad and
4. Dr. C.S. Patni, DD(PP), IPQ Division, DPPQ&S, Faridabad

Technical Experts from Manufacturers & Associations

1. Shri. Smith Shah, Director, Drone Federation of India
2. Shri. Deepak Bhardwaj, IoTech World Aviation Pvt. Ltd., Gurgaon
3. Shri. Anoop Kumar Upadhyay, IoTech World Aviation Pvt. Ltd., Gurgaon
4. Shri. Asitav Sen, CEO, Crop Life India, New Delhi
5. Dr. Sangeeta Mendiratta, Crop Science Division, Bayer Crop Science Ltd, New Delhi
6. Shri. Amit Shekhar, Mahindra & Mahindra Ltd.
7. Shri. Abhishek Burman, CEO, General Aeronautics Pvt. Ltd., Bengaluru, Karnataka
8. Shri. J.Gaur, Dhanuka Agritech, Gurgaon, Haryana
9. Shri. Ombeer Tyagi, Vice President, UPL Ltd.
10. Dr. Sandeep Singh Panwar, Advisor Scientific and Policy, PMFAI.

Annexure- III

Details of the Expert Committee Members for Drafting of SOP for Spraying Soil & Crop Nutrients by Using Drones

• Dr. Indramani, Prof. & Head, Division of Agricultural Engineering, IARI	[Chairman]
• Dr. V. N. Kale, Additional Commissioner (Machinery), M&T, DA&FW	[Member]
• Dr. V K Singh, Director, ICAR-Central Research Institute for Dryland Agriculture (CRIDA), Santoshnagar, Hyderabad, Telangana 500059.	[Member]
• Dr. Subhash Chander, Director, ICAR - National Centre for Integrated Pest Management, Pusa Campus, Pusa, Delhi.	[Member]
• Dr. Dilip Kumar Kushwaha, Scientist, Division of Agricultural Engineering, IARI	[Member]
• Dr. Sambaiah, Sr. Scientist and PI (Ag. Engg.), NG Ranga Ag. University, Guntur	[Member]
• Dr. Sunil D. Gorantiwar, Head, Agril. Engg., Faculty of Agriculture, MPKV, Rahuri	[Member]
• Shri P.K. Chopra, Asstt. Commissioner (M&T), DA&FW	[Convener]
The following special experts from academia were invited -	
• Dr. B.S. Dwivedi, Director, ICAR-NBSS&LUP, Nagpur	
• Dr. K. Sadsiva Rao, Dean, CAE &T, PJTSAU, Hyderabad	
• Dr. Rintu Banerjee, Head, Department of Agricultural & Food Engineering, IIT Kharagpur	
• Dr. Manjeet Singh, Principal Scientist, Department of FMPE, CAE&T, PAU Ludhiana	
• Dr. S.K Singh, Professor, Department of Renewable Engg., PAU Ludhiana	

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