MINISTRY OF FOOD AND AGRICULTURE

FSRP

West Africa Food System Resilience Program

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PROTOCOLS

FOR ESTABLISHING COMMUNITY FIELD DEMONSTRATIONS FOR

MAIZE

IN THE SOUTHERN, MIDDLE AND NORTHERN BELTS OF GHANA

MINISTRY OF FOOD & AGRICULTURE
REPUBLIC OF GHANA

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MINISTRY FOR FOOD AND AGRICULTURE

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DIRECTORATE OF AGRICULTURAL EXTENSION SERVICES.

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PROTOCOLS FOR ESTABLISHING COMMUNITY FIELD DEMONSTRATIONS FOR MAIZE IN THE SOUTHERN, MIDDLE AND NORTHERN BELTS OF GHANA

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1.OBJECTIVE

To introduce and enhance farmers' knowledge of nutrient-dense and a bundle of climate-smart technologies on maize, leading to increased productivity.

2. SITE SELECTION

- Select sites that are relatively flat, easily accessible and visible (preferably near roads).
- Well-drained loamy or sandy loam soil is preferred.
- Avoid gravelly and water-logged areas.

Table 1:
Target Locations for the Establishment of Maize Demonstrations

No.	Community/Location	District	Region	Varieties
1		Asante Akim North	Ashanti	
2		Atwima Kwanwoma	Ashanti	
3		Atwima Nwabiagya	Ashanti	
4		Atwima Nwabiagya North	Ashanti	
5		Ejisu	Ashanti	
6		Ejura	Ashanti	
7		Juaben	Ashanti	
8		Kumasi	Ashanti	
9		Kwabre East	Ashanti	
10		Mampong	Ashanti	
11		Offinso	Ashanti	
12		Offinso North	Ashanti	
13		Sekyere Afram Plains	Ashanti	
14		Sekyere Central	Ashanti	
15		Sekyere East	Ashanti	
16		Sekyere South	Ashanti	
17		Berekum West	Bono	
18		Dormaa Central	Bono	
19		Dormaa East	Bono	
20		Dormaa West	Bono	
21		Sunyani	Bono	
22		Sunyani West	Bono	
23		Kintampo North	Bono East	
24		Nkoranza South	Bono East	
25		Techiman	Bono East	
37		East Mamprusi	North East	
38		Mamprugu Moagduri	North East	
39		West Mamprusi	North East	
40		Gushiegu	Northern	
41		Karaga	Northern	
42		Kumbungu	Northern	
43		Nanton	Northern	
44		Savelugu	Northern	
45		Tolon	Northern	
46		Yendi	Northern	
47		Bawku West	Upper East	
48		Binduri	Upper East	
49		Bongo	Upper East	
50		Builsa North	Upper East	
51		Builsa South	Upper East	
52		Kassena Nankana	Upper East	
53		Nabdam	Upper East	
54		Talensi	Upper East	

3. LAND PREPARATION

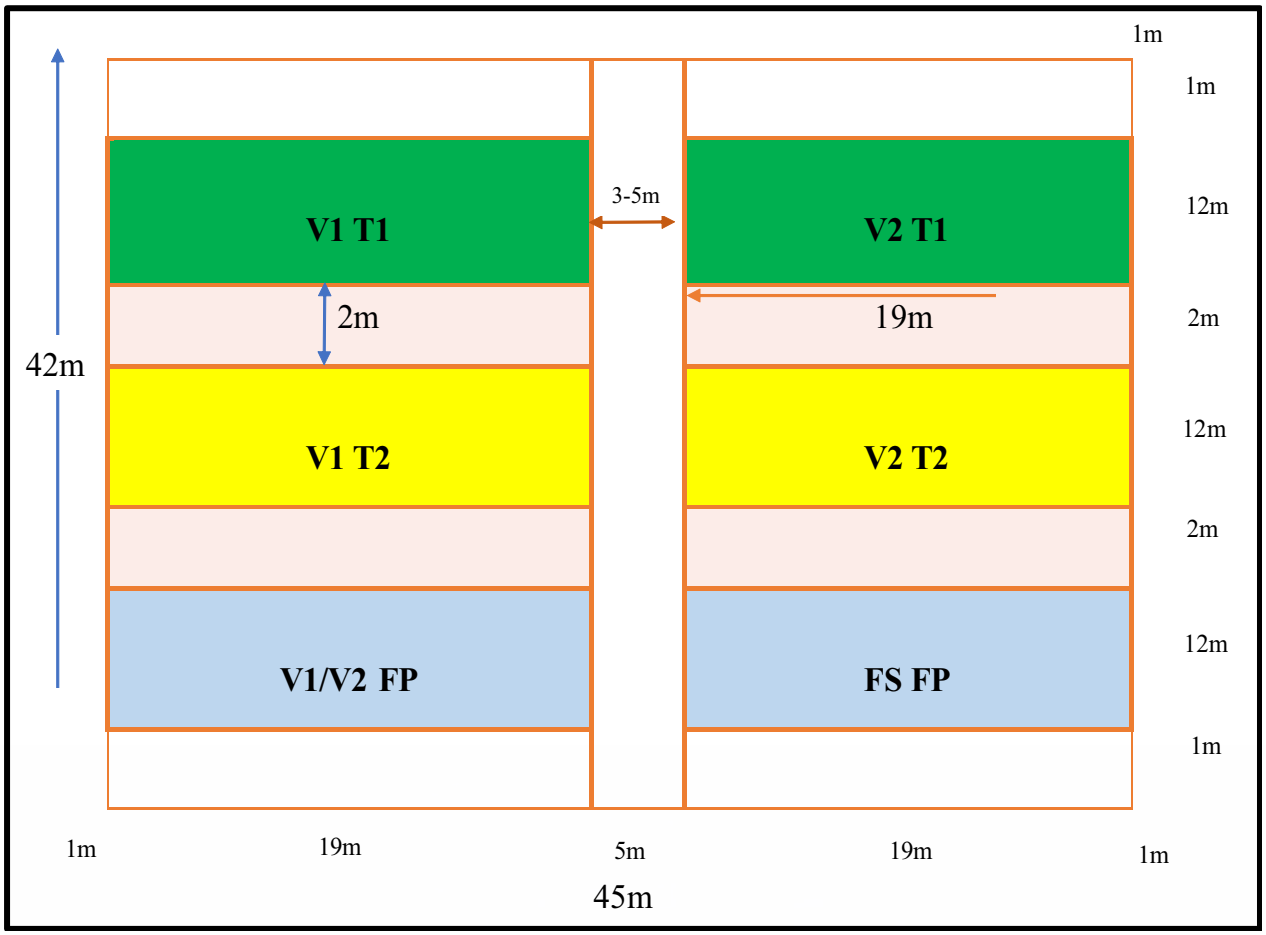
- Clear the site of any vegetation/slash, but do not burn all organic matter.
- De-stump the area if necessary to remove any shrubs/tree roots.
- Prepare the de-stumped field for sowing using either conservation or conventional tillage:
  - §For conservation tillage, slash and spray with herbicides – adopt minimum tillage (ploughing can be avoided).
  - §For conventional tillage, turn the soil using appropriate Sustainable Agricultural Mechanization (SAM) equipment - tractor-drawn, animal-drawn, etc.
- Demarcate the prepared area into 6 micro-plots (19 m x 12 m).
- Micro-plots should be separated by a 2 m spacing (micro-bunds).
- Break any soil clods to create a fine seedbed.
- Broadcast and incorporate 114 kg and 57 kg biochar at full and half rates, respectively; as well as 57 kg of organic fertilizer, into each micro-plot during land preparation (excluding farmer's plots).
- After incorporation wait for 2 weeks before planting (onset of the rains).

4.1 Field Layout (Plot Demarcation)

Table 2: Plot Demarcation

Indicators	Extra-Early/Early Maturing Variety	Intermediate/Late Maturing Variety
Number of micro-plots	6	6
Sowing distance	75 cm x 20cm	75 cm x 25cm
Micro-plot size	19 m x 12 m	19 m x 12 m
Number of rows per micro-plot	25	25
Number of plants per row	60	48
Number of plants per hill	1	1
Number of plants per micro-plot	1,500	1,200

4.2 Illustration: Field Layout



V1 = Variety 1; V2 = Variety 2; T1 = Treatment 1; T2 = Treatment 2; T3 = Treatment 3; FP = Farmer Practice; FS= Farmer Seed

5. MAIZE VARIETIES

Table 3: Maize Varieties for the Various Belts

Hybrid	Southern Belt	Middle Belt	Northern Belt
Orange/Pro vitamin A		Dzifoo Abebe	Salin-Kawana CSIR Alaafee-Kawana CSIR Adubi-Boyo CSIR Alafiya-Boyo
Yellow	Kunjor Wari	Ahuofe	Kunjor Wari
White	Opeaburo CRI-Apraku Aburo Legon		

Category	Varieties
FAW Tolerant	CSIR-Wobil Moya
New Released	Harvest Plus, Ewool, CRI Paired

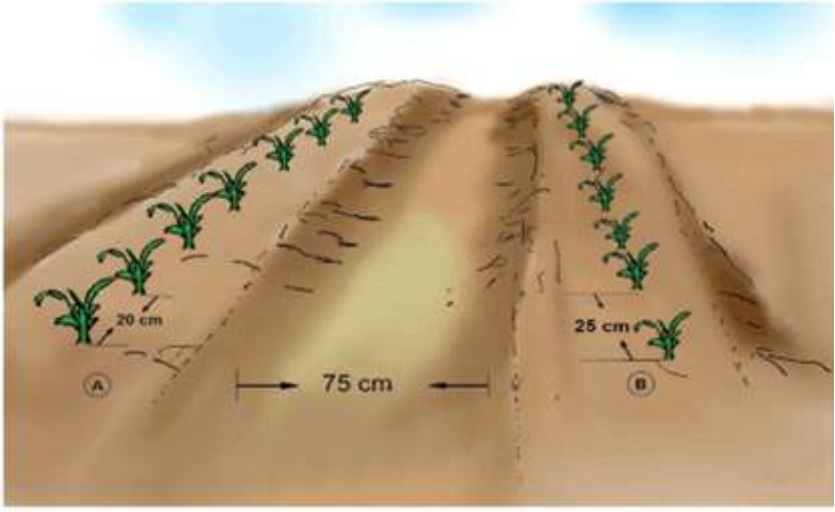
6. TREATMENT

Table 4: Treatments

Variety	Treatment 1	Treatment 2
V1	Biochar + Half rate of inorganic fertilizer	Half rate of biochar + Half rate of organic (Compost/Poultry manure etc.) and half rate of inorganic fertilizers
V2	Biochar + Half rate of inorganic fertilizer	Half rate of biochar + half rate of organic (Compost/Poultry manure etc.) and inorganic fertilizers
V1/V2/FS	Farmer practices (V1 or V2 + Full rate of inorganic fertilizer)	Farmer practices (Farmer Seed + Farmer Practice)

7. SOWING

- Do direct seeding/sowing
- Plant in rows using a garden line/rope
- Leave a spacing of 75cm between rows.
- Leave a spacing of 20cm within rows for extra-early/early (A), and 25cm for intermediate/late (B).
- Sow 2 seeds per hill and thin to 1, two weeks after sowing.
- Seeding depth should not exceed 5cm
- Refill where applicable, but not later than a week after germination



Recommended sowing spacing for extra-early/early (A) and intermediate maturing (B) varieties. Image credit: Adu et al., 2021

8. WEED CONTROL

- Keep fields clean of weeds, especially during the first 4 weeks after sowing.
- Apply recommended pre-emergence herbicide(s) immediately after sowing, not more than 2 days after sowing.
- Ensure 2 rounds of hand weeding at 3 and 5 weeks after sowing.
- Use recommended post-emergence herbicide(s) to spray the field where and when necessary.
- For post- and pre-emergence herbicide applications, ensure sufficient soil moisture.

9. PESTS AND DISEASE MANAGEMENT

(a). Pest management

Pests that affect maize production in Ghana include Fall Army Worm, Stem borers, Larger Grain Borer etc.

I. Fall Army Worm (FAW)

Damage caused by FAW. Image credit: CSIR-CRI

- Avoid late sowing and avoid sowing near infested fields.
- Scout for the presence of FAW.
- Spray recommended insecticides as soon as signs and symptoms such as egg masses, window panes, and larvae are seen on leaves.
- Spraying early in the morning or evening is recommended, and sprayer nozzles must be directed into the maize whorl.

Examples of recommended insecticides include:

1. Bacillus thuringiense + Pieris rapae - 15g/15L water
2. Sophora flavescens plant extract (25 %) + Emamectin benzoate (1 %) 20 ml/15/L knapsack sprayer.
3. Azadirachtin (3%) 50ml/15/L knapsack sprayer.
4. Bacillus thuringiensis var kurstaki 15g/15L knapsack sprayer.
5. Bacillus thuringiensis (55%) + Monosultap (45%) 50g/15L knapsack sprayer.
6. Ethyl palmitate (100mls/15L knapsack sprayer).
7. Emamectin benzoate - 30g/15L of water (there are several liquid formulations, and the correct dosage must be checked on the label).

(b). Disease management

- Diseases that affect maize in Ghana include maize streak disease, common rust, maize grey leaf spot, maize leaf blight and maize smut.
- Practice good farm sanitation.

10. FERTILIZER APPLICATION

(a). Basal Fertilizer

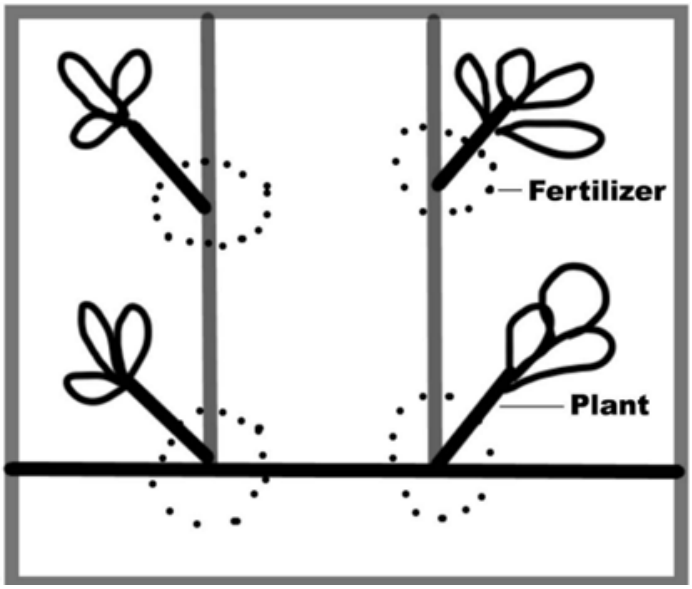
- Apply NPK 15-20-20+0.7Zn, at sowing to 7 days after sowing using the rates presented in Tables 2 and 4. However, ensure there is moisture in soil before application.

- Apply the appropriate quantity of fertilizer per plant as shown in Tables 2 and 4 based on the variety planted.

- Apply fertilizer at a spot (band placement) or in a ring (about 5cm from the base of the crop).

- Do not apply fertilizer when the soil is dry.

Basal fertilizer application at 2 weeks after sowing. Image credit: Adu et al., 2021



Consider this picture for ring placement

(a). Top dressing

- Apply Urea (46 % N) 4-5 weeks after sowing using the rates in Tables 4, 5 and 7.

- Apply the appropriate quantity of fertilizer per plant as shown in Tables 4, 6, and 8 based on the variety planted.

- Apply fertilizer at a spot (about 5cm from the base of the crop) and bury it under wet/moist conditions.

- Do not apply fertilizer when the soil is dry.

Top dressing at 4-5 weeks after planting. mage credit: Adu et al., 2021

10.2 Fertilizer Application Rates

Table 5: Fertilizer Application Rates for Maize in the Southern and Middle Belt

Treatment	Soil Practice	Quantity of fertilizer to apply (kg/plot)			
		Biochar	Compost	N: P: K 15:20:20 + Zn	Urea
V1T1	Biochar [1] + ½ rate inorganic fertilizer [2]	114	0	3.42	1.14
V1T2	½ rate of biochar + combination of ½ rates of organic and inorganic fertilizers [3]	57	57	3.42	1.14
V2T1	Biochar [1] + ½ rate inorganic fertilizer [2]	114	0	3.42	1.14
V2T2	½ rate of biochar + combination of ½ rates of organic and inorganic fertilizers	57	57	3.42	1.14
V1/V2 FP	Farmer Practice	-	-	-	-
FS FP	Farmer Practice	-	-	-	-

NB: Biochar[1] The recommended rate of biochar used is 5 t/ha.
Thus, the half rate is 2.5 t/ha

Inorganic fertilizer[2] The rate used is 90:60:60 N: P_2O_5: K_2O kg/ha + 1.7 kg/ha Zn.
Thus, half rate of inorganic fertilizer is 45:30:30 N: P_2O_5: K_2O kg/ha + 0.9 kg/ha Zn

Half rate of organic fertilizer[3] The recommended full rate is 5 t/ha.
Thus, the half rate is 2.5 t/ha of compost/poultry manure

Table 6: Fertilizer Application Rates for Maize per plant/hill in the Southern and Middle Belt

Treatment	Soil Practice	Quantity of fertilizer to apply (g/plant)			
		Extra early/early varieties		Intermediate /Late varieties	
		Basal	Top dress	Basal	Top dress
		N: P: K 15:20:20 + Zn	Urea	N: P: K 15:20:20 + Zn	Urea
V1T1	Biochar [1] + ½ rate inorganic fertilizer [2]	2.28	0.76	2.85	0.95
V1T2	½ rate of b iochar + combination of ½ rates of organic and inorganic fertilizer s[3]	2.28	0.76	2.85	0.95
V2T1	Biochar [1] + ½ rate inorganic fertilizer [2]	2.28	0.76	2.85	0.95
V2T2	½ rate of b iochar + combination of ½ rates of organic and inorganic fertilizer s	2.28	0.76	2.85	0.95
V1/V2 FP	Farmer Practice	-	-	-	-
FS FP	Farmer Practice	-	-	-	-

Table 7: Fertilizer Application Rates for Maize in the Northern Belt

Treatment	Soil Practice	Quantity of fertilizer to apply (kg/plot)			
		Biochar	Compost	N: P: K 15:20:20 + Zn	Urea
V1T1	Biochar [1] + ½ rate inorganic fertilizer [2]	114	0	2.28	3.03
V1T2	½ rate of b iochar + combination of ½ rates of organic and inorganic fertilizer s[3]	57	57	2.28	3.03
V2T1	Biochar [1] + ½ rate inorganic fertilizer [2]	114	0	2.28	3.03
V2T2	½ rate of b iochar + combination of ½ rates of organic and inorganic fertilizer s	57	57	2.28	3.03
V1/V2 FP	Farmer Practice	-	-	-	-
FS FP	Farmer Practice	-	-	-	-

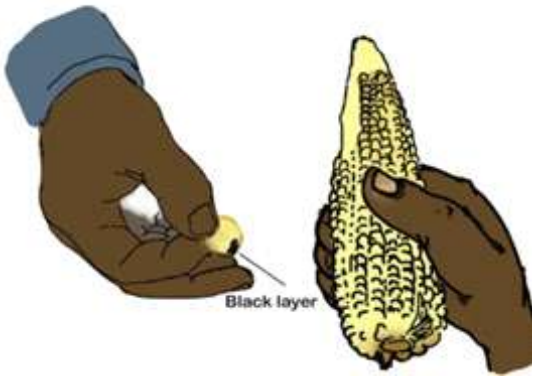
NB: Biochar[1]: The recommended rate of biochar used is 5 t/ha. Thus, the half rate is 2.5 t/ha
Inorganic fertilizer[2]: The rate used is 100:40:40 N: P_2O_5: K_2O kg/ha + 1.7 kg/ha Zn.
Thus, half rate of inorganic fertilizer is 45:20:20 N: P_2O_5: K_2O kg/ha + 0.9 kg/ha Zn
Half rate of organic fertilizer[3]: The recommended full rate is 5 t/ha. Thus, the half rate is 2.5 t/ha of compost.

Table 8: Fertilizer Application Rates for Maize per plant in the Northern Belt

Treatment	Soil Practice	Quantity of fertilizer to apply (g/plant)			
		Extra early/early varieties		Intermediate /Late varieties	
		Basal	Top dress	Basal	Top dress
		N: P: K 15:20:20 + Zn	Urea	N: P: K 15:20:20 + Zn	Urea
V1T1	Biochar [1] + ½ rate inorganic fertilizer [2]	1.52	2.02	1.9	2.53
V1T2	½ rate of b iochar + combination of ½ rates of organic and inorganic fertilizer s[3]	1.52	2.02	1.9	2.53
V2T1	Biochar [1] + ½ rate inorganic fertilizer [2]	1.52	2.02	1.9	2.53
V2T2	½ rate of b iochar + combination of ½ rates of organic and inorganic fertilizer s	1.52	2.02	1.9	2.53
V1/V2 FP	Farmer Practice	-	-	-	-
FS FP	Farmer Practice	-	-	-	-

NB: Broadcast and incorporate 114kg and 57 kg of biochar at full and half rates, respectively, into each plot during land preparation (excluding farmer's plots).
Also, incorporate the compost on designated plots during land preparation (excluding farmer's plots) 2 weeks before sowing.

11. HARVESTING



Black layer visible on a maize grain. Image credit: CSIR-SARI

•A field book, weighing scale, bag or bucket for collecting maize cobs, a pencil and a tape measure will be needed for harvesting.

•Harvest maize at physiological maturity, provided adequate facilities are available for drying. Physiological maturity is the stage where a "black layer" develops at the point of attachment of the grain to the cob.

•For data collection, sampling will cover a total of 19.6 m^2 per treatment. This should be done during the first fertilizer application.

•Leaving out 2 border rows at the beginning and end of a plot, measure 2 sub-plots of 2.4 m across rows x 4m along rows at two randomly selected locations per treatment.

•All plants within the two sub-plots must be harvested.

•During harvesting, remove all cobs of harvested plants.

•De-husk all the cobs and weigh the de-husked cobs.

•Put all de-husked cobs into a labelled sack with the treatment name and sub-plot number.

•Carry the labelled sacks containing the de-husked cobs to the office for further processing

Images credit: CSIR-SARI

12. FIELD DAYS

Table 9: Field Days

Field days	Activity
First Field Day	Land preparation, demarcation and Biochar Application (1st incorporation)
Second Field Day	Sowing (2 weeks after the rains)
Third Field Day	Fertilization
Fourth Field Day	Fertilization /FAW Control
Fifth Field Day	Harvesting and Yield Assessment

General Information

1. Expectations

a.The Size of the demo must be achieved to be accepted as a demo

b.The host farmer must be ready and willing to provide labour for the establishment and maintenance of the demo.

c.Demo plots shall be sited along the farmers' route

d.There should be a distance/alley between the demo plot and neighbouring farms

2. Responsibilities

2.1 Partner
a.Provides land for the demonstration
b.Takes care of land preparation
c.Takes care of field-sowing, fertilizer application, weeding, and harvesting

3.0 Project:
a.Provide other related costs (Inputs, meetings, incidentals)
b.Monitoring of Demo at various stages

3.1 Have a signpost showing:

- The treatment (s) being tested.....
- Contact information for inquiries about the demo.....

3.2 Demo Size: Half of an acre

3.3 Name of Partner .....

3.4 Name of Field Officer: .....

3.5 Name of Lead Farmer: ..... (Female/Male)

3.6 Region: ..... District: ..... Town: .....

3.7 GPS coordinates of demo plot: .....

3.8 Previous crop: .....

3.9 Please include weather data for the demo location, where available.

3.10 Record the sowing and harvesting dates, as well as the weight of the harvested cobs, in the tables provided below:

Sowing Date

Treatment	V1T1	V1T2	V1T3	V2T1	V2T2	V2T3	V1/V2 FP	FS FP
Sowing date								

Harvesting Date

Treatment	V1T1	V1T2	V1T3	V2T1	V2T2	V2T3	V1/V2 FP	FS FP
Harvesting date								
Weight (sub - plot 1)								
Weight (sub - plot 2)								

4.0 General observations.....

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5.0 Data Collection Plan for Demonstration

Farmers' comments on technologies during field days/visits

S/No.	Name	Age (≥18)	Disabled		Gender		Assessment of Technology (Like or Dislike)	Reason for like or dislike
			Yes	No	M	F		
1.								
2.								
3..								
4.								
5.								
6.								
7.								
8.								
9.								
10.								
11.								
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13.								
14.								
15.								

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