ADAPTIVE RESEARCH FOR GRAIN PRODUCTION (BRUMDEC)

(A Short Term Programme)

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(A SHORT TERM PROGRAMME)

BY

CLAUDE GRAND-PIERRE
GRAIN PRODUCTION SPECIALIST
IICA/JAMAICA

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ADAPTIVE RESEARCH FOR GRAIN PRODUCTION (BRUMDEC)

(A SHORT TERM PROGRAMME)

Claude Grand-Pierre
Grain Production Specialist
IICA Consultant

1. INTRODUCTION

The Black River Upper Morass Development Company Limited (BRUMDEC) is the legally authorized executing agent of the Black River Morass Reclamation Project. The Project is concerned with the development of approximately 4,451 ha (11,000 acres) of land in the Elim and Barton Isle areas of St. Elizabeth, and the company plans to cultivate the following crops: onions, peas and beans, rice, corn, pineapple, cassava, mango, citrus, sugar cane, coffee, vegetables, plantain and peanuts.

One of the objectives of the BRUMDEC includes: the initiation of Research and Development for introducing improved agricultural production techniques and to provide technical assistance to farmers in the area. As a consequence, BRUMDEC has signed on the 19th December 1980, an agreement with the Inter-American Institute for Co-operation on Agriculture - (IICA) for the provision of five (5) consultants in the area of :-

(a) rice production
(b) grain crop production
(c) vegetable crop programme
(d) irrigation and drainage management; and
(e) farmers organization.

In relation to grain crop production, the Grain Production Specialist is expected to prepare a short term programme of Adaptive Research for Grain Crop Production with the objective of determining the most economic cropping pattern aimed at solving the problems which obtain in grain production with special reference to corn, sorghum and legumes under the conditions of the Project Area of BRUMDEC. To this end cereals and grain legumes will be produced on trial plots to identify important production constraints and to suggest and recommend ways of removing these constraints.

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[illegible]
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In this context a programme of adaptive research is herewith proposed.

2. BACKGROUND

In order to develop a viable system of agricultural production for a given area it is imperative that an examination be made of Agro-climatic factors: such as weather, and water resources, financial, physical and human resources. For this reason a discussion of these parameters is relevant.

2.1 Location

The Black River Morasses are divided into the Upper Morass and the Lower Morass. They are situated in the Western part of Jamaica near the south coast in the parish of St. Elizabeth. The Upper Morass area envisaged for agricultural development by BRUMEC is situated between Maggotty in the north and Lacovia in the south. It consists of approximately 4,451 hectares (11,000 acres) of land. The Lower Morass extends from Middle Quarters in the north to the Black River Bay in the south and covers a much greater area than the Upper Morass. A more detailed presentation on the location of the Morasses appears in chapter one of the detailed report titled "Black River Morasses Reclamation Project". (2)

2.2 Climatic Conditions

(i) Rainfall

The climatic conditions of the Project Area have been reported on in detail. (2) Presented in Table I are figures of average annual rainfall, and evapo-transpiration of the Upper Morass area. As indicated there are two distinct rainy seasons viz; April through May and August through October. The drier months are, December, January and February where potential evapo-transpiration exceeds rainfall. The months of heaviest rainfall are May and October:

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2. Location

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2.1 Location

The Upper River Potaro is divided into ... the Upper Potaro and the Lower Potaro. They are located in the Western part of Guyana near the central ... the parish of St. Elizabeth. The Upper Potaro area is designated for agricultural development by ... GMC is situated between Mazaruny in the north and Essequibo in the south. It consists of approximately 4,251 square miles (11,000 sq.km) of land. The Lower Potaro extends from Mile Quarters in the north to the Upper Potaro Rapids in the south and covers a small proportion of the ... when the Upper Potaro ... A more detailed presentation on the location of the Potaro appears in chapter one of the detailed report titled "Tiboa River Potaro Valley ... Project". (2)

2.2 Climatic Conditions

(i) Rainfall

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TABLE 1 AVERAGE RAINFALL AND EVAPOTRANSPIRATION IN THE UPPER MORASS

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Average rainfall	58.4	81.2	108.9	221.9	275.3	139.7	125.9	234.9	220.4	342.6	165.1	76.9
Evapotranspiration	84.0	87.8	105.6	114.3	124.9	110.9	125.4	114.5	91.9	91.1	77.4	80.5

Source: Black River Morasses Reclamation Project GOJ(MAL)GRONTMIJ Consulting Company of the Netherlands, 1964

This rainfall pattern will to a large extent determine the future rotation programme for Grain Production in the area.

(ii) Temperature

There are no temperature records for the area but it is unlikely that the St. Elizabeth plains will differ significantly from the generally accepted pattern for the coastal plains of Jamaica. From statistics available for the coastal plains the temperature ranges are as follows:

	Hottest Month	Coolest Month
Average daily maximum	32.8 C (91F)	26.1 C (79F)
Average daily minimum	21.1 C (70F)	16.7 C (62F)

(iii) Humidity

Again there are no humidity records for the project area. Records for other coastal areas of the island indicate that humidity is very high during the night but drops rapidly during the day and reaches a minimum at about 3 P.M. This overall pattern can change by rain falling during the day.

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	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
[illegible]	56.4	81.2	170.6	222.4	247.4	230.7	125.0	234.0	227.	242.5	165.1	73.3
[illegible]	41.0	92.4	105.6	114.7	174.-	110.0	127.4	114.7	91.3	91.1	77.4	49.5

Source: Block Five - Jamaica Irrigation Project (GOJ(PAL)(COMP.1))
Consulting Corporation for Tropical Agriculture, 1964

This rainfall pattern will to a large extent determine the future rotation program for grain production in the area.

(ii) Temperature

There are no recording records for the area but it is unlikely that the Sir Lindsay Clayton plains will differ significantly from the generally accepted pattern for the coastal plains of Jamaica. From statistics available for the coastal plains the temperature trends are as follows

	Hottest Month	Coolest Month
Average daily maximum	32.2 C (91F)	29.1 C (85F)
Average daily minimum	21.1 C (70F)	18.7 C (65F)

(iii) Humidity

There are no humidity records for the project area. Records for other coastal areas of the Island indicate that humidity is very high during the night and drops rapidly during the day to reach a minimum at noon. The usual weather pattern can change by rain falling during the day.

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2.3 Major Soil Types in the Project Area

2.3.1 Morass Peat Soil No. 152

This soil is most widespread in the project area and is derived under swamp conditions from sawgrass, Claudium jamaicance and other related sedges. Depending on the level of the water table solid black peat forms a mat on the surface which overlies rotting vegetation mixed with water to depths which vary from 0.30m to over 2.10m until bluish grey clay and sandy clay is encountered. (3)

As shown in Table 2 the soil reaction of Morass Peat is slightly acidic (pH 6.4). Levels available P_2O_5 are medium (71ppm) whereas exchangeable potash is very low (58 ppm) for adequate crop growth. Exchangeable magnesium appears adequate (670 ppm) but calcium is strikingly high (7,643 ppm). It is very possible that such a high calcium level may result in induced deficiencies of manganese, iron and zinc. Soil management studies conducted on peaty soils in the Everglades of Florida indicate that the judiciuos use of trace elements coupled with good pest management can result in satisfactory yields of cereal and vegetable crops. (5)

2.3.2 Four Paths Series of Soils

Four Paths Clay - 203 - Four Paths Loam - 204

These soils are the second most widespread within the project area. They are highly weathered and strongly leached. As presented in Table 2 they are highly acidic (pH. 5.4) deeply and infertile for the most part. (3)

Four Paths Clay - 203 consists of a deep layer of friable top-soil. Although highly acidic and infertile (Table 3) this soil would support adequate crop growth if well managed.

Four Paths Sandy Loam - 204 may be regarded as the most infertile in the project area due to the fact that the highly mottled and poorly drained sub-soil is covered by a thin layer of sand or gravel. (3)

2.3.3 Wallens Clay - 9A

The parent material of Wallens Clay in the Project area is yellow alluvial material. Phosphate is low in some areas whereas in others it is adequate. That this is so is a reflection of the use of fertilizer on rice and sugar cane. Potash is generally low, while magnesium levels are adequate. (Table 2).

2.3.4 Cashew Clay Loam - 151

This soil is acidic, heavy textured and may be regarded as being of low fertility (Table 2). Phosphate and potash are very low and inadequate for most crops. Calcium and magnesium are adequate and no lime application are needed on this soil. (3)

TABLE 2 Nutrient levels of the major soil types (BRUMDEC)

Soil types	Depth cm	pH	Phosphate ppm K_2O	Phosphate ppm P_2O_5	Magnesium ppm Mg	Calcium ppm Ca	% Organic matter
Morass Peat - 151	0-45	6.4	70.5	58.0	668.6	7,643	29.1
Four Paths Clay- 203	0-45	5.4	63.0	27.2	94.8	670	3.0
Four Paths Sandy Loam - 204	0-45	5.1	33.2	30.0	118.2	722	3.1
Wallens Clay- 9A	0-45	7.4	70.5	58.3	463.1	5,643	3.5
Cashew Clay Loam -151	0-45	6.3	36.2	43.4	223.7	3,070	2.9

Source: Report on the detailed soil survey of the Upper Morass (3)

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2.3.3 Textures (T) -

The percentage of silt and clay in the subsoil gave an indication of the texture. Most of the soils were loamy, while the sandy soils were mostly found in the valley bottoms. (Table 2).

2.3.4 Organic Carbon (C) -

This soil property was determined using the Walkley and Black procedure as described by Allison (1965). The results are presented in Table 2.

Table 2 [illegible]

[illegible]	Depth (cm)	[illegible]	[illegible]	[illegible]	[illegible]	% Organic matter
[illegible] Peat - ISI	0-45	6.4	70.5	78.0	[illegible]	2%
[illegible] Clay- [illegible]	0-45	[illegible]	93.0	22 2	[illegible]	3.0
[illegible] Peaty [illegible]	0-45	3.1	53..	34.0	113.7	3.1
[illegible] (Ig -- Da	0 15	7.4	23.5	73.3	4[illegible].1	3.[illegible]
[illegible] Clay loam	0-45	6.3	51..	44.4	223.7	2.[illegible]

Source: Remote sensing of soil properties (5)

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2.4 Drainage and irrigation facilities

The present situation existing in the Upper Morass is characterized by periodic inundations caused by the Black River in the wet seasons. As a consequence the land suffers from increasingly inadequate removal of the ground water and rain water. To remedy this situation the actual drainage construction would start in September 1979 and is currently in progress. A contract for the irrigation design was signed on January 1980 and according to available information, surveying work for the actual design of the irrigation works is completed and the actual work is in progress. (1)

2.5 Financial Aspects

The project was initially estimated to cost US$18.5 million with all ultimate construction/development elements estimated to cost US$15.0 million including equipment, contingencies and escalation. But the up-dated budget of the project has an estimated total cost of US$30.5 million while the approved available financial resources is US$18.5 million comprising of : (1)

	US$
IDB Loan	12.5M
OPEC Loan	3.0
GOJ Contributuon	3.0

2.6 Physical and human resources

In consonance with the projected staffing arrangements BRUMDEC is not yet fully staffed. Presently the key personnel employed on the project are as follows:

- -The Project Manager
- -The Administrative Officer
- -Farm Superintendent (presently counterpart to the Rice Consultant)
- -Crop Production Officer (presently counterpart to the Grain Production Consultant)
- -Rice Production Specialist (IICA/Consultant)
- -Grain Crop Production Specialist (IICA/Consultant)

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A workshop is utilized for the maintenance of pumps, irrigation, cultivation, drainage and harvesting equipment and service vehicles.

Present BRUMDEC activities in crops production are as follows:

- Rice approximately	200 ha
- Coffee "	4 ha
- Mango "	7 ha
- Avocado "	3.5 ha
- Pineapple "	12 ha
- Cassava "	12 ha

3. OBJECTIVES OF THE PROGRAMME OF ADAPTIVE RESEARCH FOR GRAIN PRODUCTION

On the basis of the parameters reviewed above cereals and grain legumes will be produced on a series of trial plots to identify production constraints and to suggest and recommend ways of removing these constraints. To this end a programme of adaptive research is proposed initially to determine:

3.1 Factors limiting production of grain cereals and legumes;

3.2 The ideal technological practice for each crop with respect to each soil type.

4. METHODOLOGY

The agronomic research and testing proposed is an adaptation of the CIMMYT Procedure (4) which is aimed at developing in the shortest possible time improved practices for increasing yields and net income of different crops.

The initial field work is conducted in a sequence of two steps i.e., testing of and fitting of appropriate technological alternatives for commercial grain crop production.

4.1 Step 1

Various trials are established to determine the limiting factors to grain crop production in the project area. Emphasis is placed on experiments which will identify critical management factors (in terms of priority and interactions) and to detect factors of production which

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have the highest impact on cost/benefits and simultaneously which will find a high degree of acceptance by producers.

The field data obtained from this step will supply the information needed to determine those factors which are economically relevant and which must be considered in the experiments programmed for the next step.

4.2 Step 2

In this step, experiments are designed specifically to evaluate the effects of different levels of those critical factors which were identified in step one. Emphasis is placed on experiments which are aimed at quantifying the agro-economic response to each critical management factor. Ancillary trials will be established to identify inter alia appropriate pesticides and herbicides, and appropriate tillage methods and levels; optimum crop density and optimum fertilizer levels. Data from these studies will be used in the :

(i) formulation of technological alternatives (packages) with different levels of benefits and associated risks;

(ii) partial budget analysis of agronomic data; and

(iii) spectrum of relevant economic factors to be considered for future long-term trials.

5. Grain Crops envisaged

5.1 Grain cereals component

The grain cereal components will include corn and sorghum.

5.2 Legume component

Initially the studies will be confined to cowpea. During the second phase Pigeon Pea, Red Pea and Peanut will be considered as well as cowpea.

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6. Trials proposed during Phase One

6.1 Relevance of production factors trial

Objectives

- To identify the most critical production factors under the project area conditions of BRUMDEC.
- To determine the effect of withholding one practice from the complete set of basic production practices.

Treatments

In each plot the Basic Production Package (BPP) is applied or the BPP minus one factor. The BPP consists of (x) kg N/ha + (y) kg P_2O_5/ha + (w) kg K_2O/ha + improved variety + optimum density + use of herbicide + use of insecticide + (g) micro-elements (Table 4)

Treatment	Inputs
1	BPP (all factors applied)
2	BPP-N (no N applied)
3	BPP-P (no P applied)
4	PPP-K (no K applied)
5	BPP-M.E. (no Micro-elements applied)
6	BPP-I (no insecticide applied)
7	BPI-H (no herbicide applied)
8	BPP-D (2) (other population density)
9	V only (no N,P,K,M,E,H. or I used)

Experimental Design

A randomized complete Block Design having 4 replications.

Plot Size

Corn : Six (6) row, 10m long with 0.80m between rows and 0.50m between hills.

Sorghum: Six (6) rows, 10m long with 0.80m between rows and 0.06m between plants (18 plants per linear meter).

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Cowpea: Six (6) rows, 10m long with 0.45m between rows and 0.09m between plants (12 plants per linear meter).

TABLE 4 : Basic Production Package for each crop (Fertilizer regime)

INPUTS	CORN	SORGHUM	COWPEA
Kg N/Ha	100	100	50
Kg P_2O_5/Ha	80	80	80
Kg K_2O/Ha	80	80	80
Kg FTE-BR 12 (Micro-elements)	20	20	20
Density-Plants/ha (1)	50,000	222.000	245.000
Density-Plants/ha (2)	25.000	140.000	155.000

6.2 Basic Fertilizer Experiment

Objectives

- To compare the yield response due to four different fertilizer nutrients under the Project area conditions
- To identify significant interactions between fertilizer nutrients.

A - Nitrogen (N)	N_1 (X_1) Kg N/Ha
	N_2 (X_2) Kg N/Ha
B - Phosphorus (P)	P_1 (y_1) Kg P_2O_5/Ha
	P_2 (y_2) Kg P_2O_5/Ha
C - Potash (K)	K_1 (z_1) Kg K_2O/Ha
	K_2 (z_2) Kg K_2O/Ha
D - Micro-elements (FTE-BR12)	$M.E_1$ (w_1) Kg M.E/Ha
	$M.E_2$ (w_2) Kg M.E/Ha

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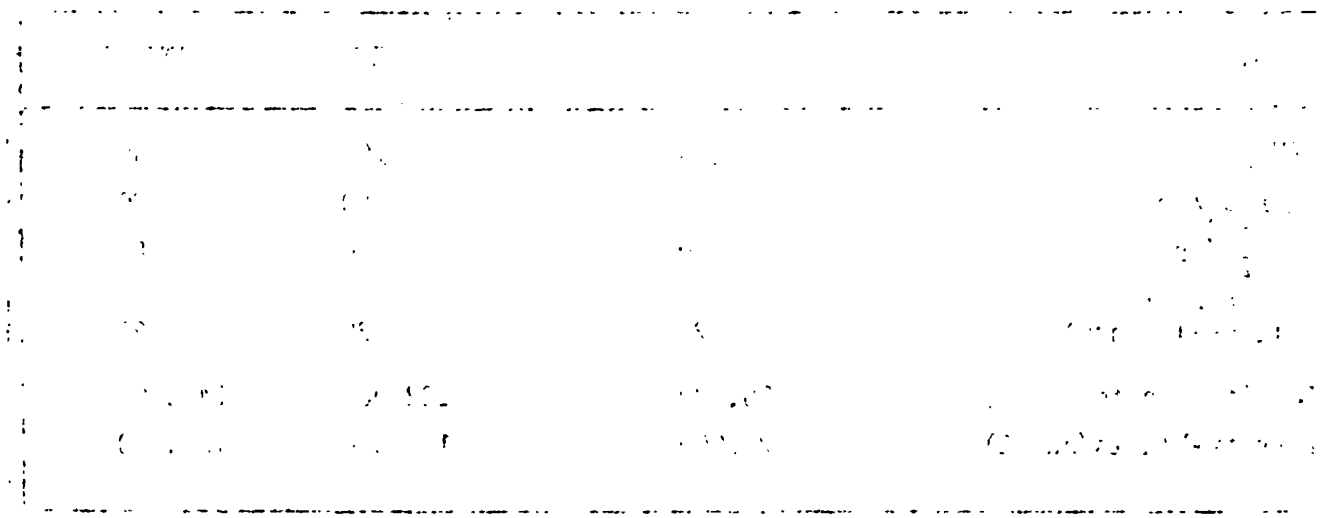

TREATMENTS	CORN	SORGHUM	COWPEA
N_1	50 Kg N/ha	50 Kg N/ha	50 Kg N/ha
N_2	100 Kg N/ha	100 Kg N/ha	100 Kg N/ha
P_1	50 Kg P_2O_5/ha	50 Kg P_2O_5/ha	50 Kg P_2O_5/ha
P_2	100 Kg P_2O_5/ha	100 Kg P_2O_5/ha	100 Kg P_2O_5/ha
K_1	50 Kg K_2O/ha	50 Kg K_2O/ha	50 Kg K_2O/ha
K_2	100 Kg K_2O/ha	100 Kg K_2O/ha	100 Kg K_2O/ha
M.E.	15 Kg FTE/ha	15 Kg FTE/ha	15 Kg FTE/ha
M.E.	30 Kg FTE/ha	30 Kg FTE/ha	30 Kg FTE/ha

Experimental Design:

This experiment is a randomized complete block design with 3 replications. The plots are arranged as a 2^4 factorial in blocks of 8 treatments with the 4 4 factor interaction confounded with blocks.

PLOT SIZE

Corn : Six (6) rows, 10m long with 0.80m between rows and 0.50m between hills.

Sorghum : Six (6) rows, 10m long with 0.8)m between rows and 0.06 between plants.

Cowpea : Six (6) rows, 10m long with 0.45m between rows and 0.09m between plants.

There are two (2) experiments for each crop (3) in each soil types (4) for a total of twenty four (24)trial plots in the step one. The experiments in the second step are designed specifically to evaluate the effects of using different levels of those critical factors which were identified in step one. The experimental results determine the best varieties, plant population, optimum

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fertilizer levels and application rate of herbicides and insecticides. The object is to find the optimum economic rates for inputs and to determine the ideal technological practice for each crop in respect to each soil type, considering:

A - the inherent nutritional status of the soil; and

B - the nutritional crop requirement for satisfying genetic yield potential.

On the basis of the information supply by the experimental results in step one, the following plot trials are envisaged:

6.3 Fertilizer Experiment

Objectives

To determine an optimum economic fertilizer rate under the Project Area conditions.

6.4 Weed Control Experiment

Objectives

To determine the effectiveness of two or three herbicides in crop protection and to assess the economic benefits of weed control with herbicides.

6.5 Insect Control Experiment

To compare the effectiveness of two or three insecticides on crops grown under conditions of the Project area and to assess the economic benefits of crop protection with insecticides.

6.6 Variety X Density Experiment

Objectives

To compare hybrids and/or promising commercial or experimental varieties and to examine the interactions between these varieties and crop population densities.

6.7 Pre-verification Trial

Objectives

To observe a range of improved practices for increase yields and net income.

7. PERSONNEL

The personnel required for the programme are as follows:
One (1) Grain Production Officer (BRUMDEC's Counterpart)
Three (3) Technicians
Fifteen (15) workers

8. LAND

Three (3) acres in the Morass Peat
Three (3) acres in the Wallens Clay
Three (3) acres in the Four Path Clay
Three (3) acres in the Cashew Clay

9. MATERIALS* and EQUIPMENT

(see list in Annex 1)
* Materials only for STEP 1

10. CHRONOGRAM OF ACTIVITIES (TENTATIVE)

(See Annex 2)

11. FIELD OFFICE FACILITIES

Facilities must be offered for implementation and maintenance of the programme.

12. REMARKS

As a consequence of limited time and the present rainfall situation there will probably be a significant gap between the planning schedule and execution work if the land preparation, personnel and materials

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are not ready at end of June. On such an occasion the first trials will be established in August and the step two (2) will be in December.

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ANNEX 1

LIST OF PRODUCTS (STEP 1)

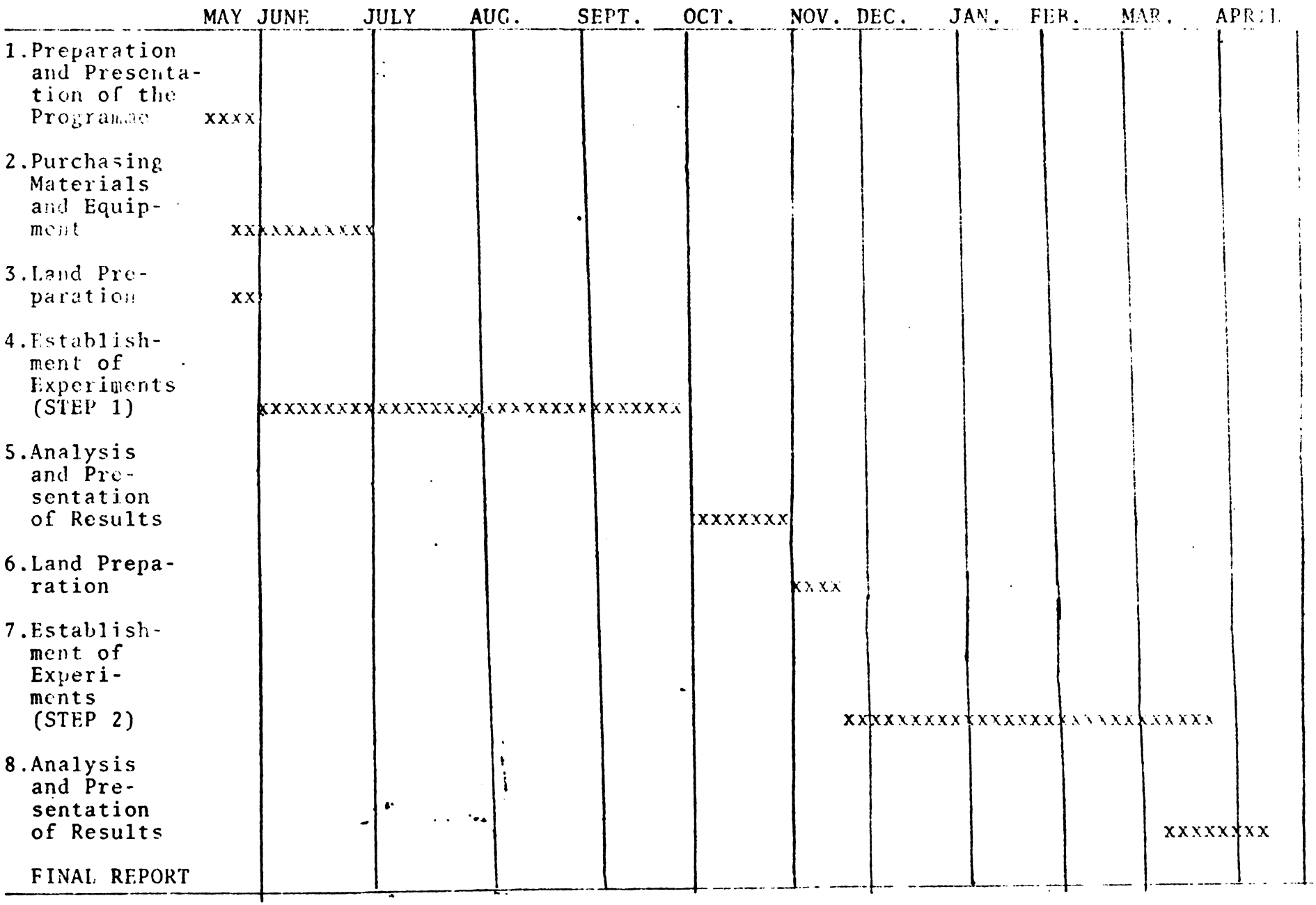
Items	Quantity	Cost
Corn: Pioneer x 304 A	30 lbs.	
Sorghum: Pioneer 8244	30 lbs.	
Cowpea: African Red Variety	60 lbs.	
Other seeds: Peanuts, Pigeon Peas		
Fertilizers:		
Urea (45%)	90 Kg	
Triple Superphosphate (40-50%)	150 Kg	
Sulphate of Potash (48%)	165 Kg	
FTE-BR 12 (free trace elements)	45 Kg	
Insecticides and Fungicides:		
Furadan (5% a.i.)	30 Kg	
Sevin 80% W.P.	30 Kg	
Diazinon	15 Lt.	
Benlate	30 lbs.	
Herbicides:		
Gesaprim - Combi 80	8 Kg	
Probe	8 Kg	

ANNEX B

LIST OF MATERIALS

Items	Quantity	Cost
Wooden Stakes	500	
Hammer or Striker	4	
Strings (333 ft.)	3	
Measuring Tape (30 cm)	3	
Measuring Cups (250 cc)	30	
Plastic Cans (20 Lt.)	15	
Knapsack Sprayers	10	
Graduated Plastic Cylinder (1000 ml)	5	
Graduated Plastic Cylinder (100 cc)	5	
Moisture Meter	1	
Burrow Gram Scale (triple beam)	1	
Soil Moisture Meter	1	
Soil Auger	1	
Rakes	10	
Hoes	15	
Machetes	15	
Buckets (20 lt.)	15	
Plastic Bags (40 x 20 cm)	300	
Tags (a lot of Marking Pencils)	10	
Field Books	30	
Stapler	6	
Wooden Marking Frame 2" x 1" with four (4) divisions	2	

CHRONOGRAM OF ACTIVITIES



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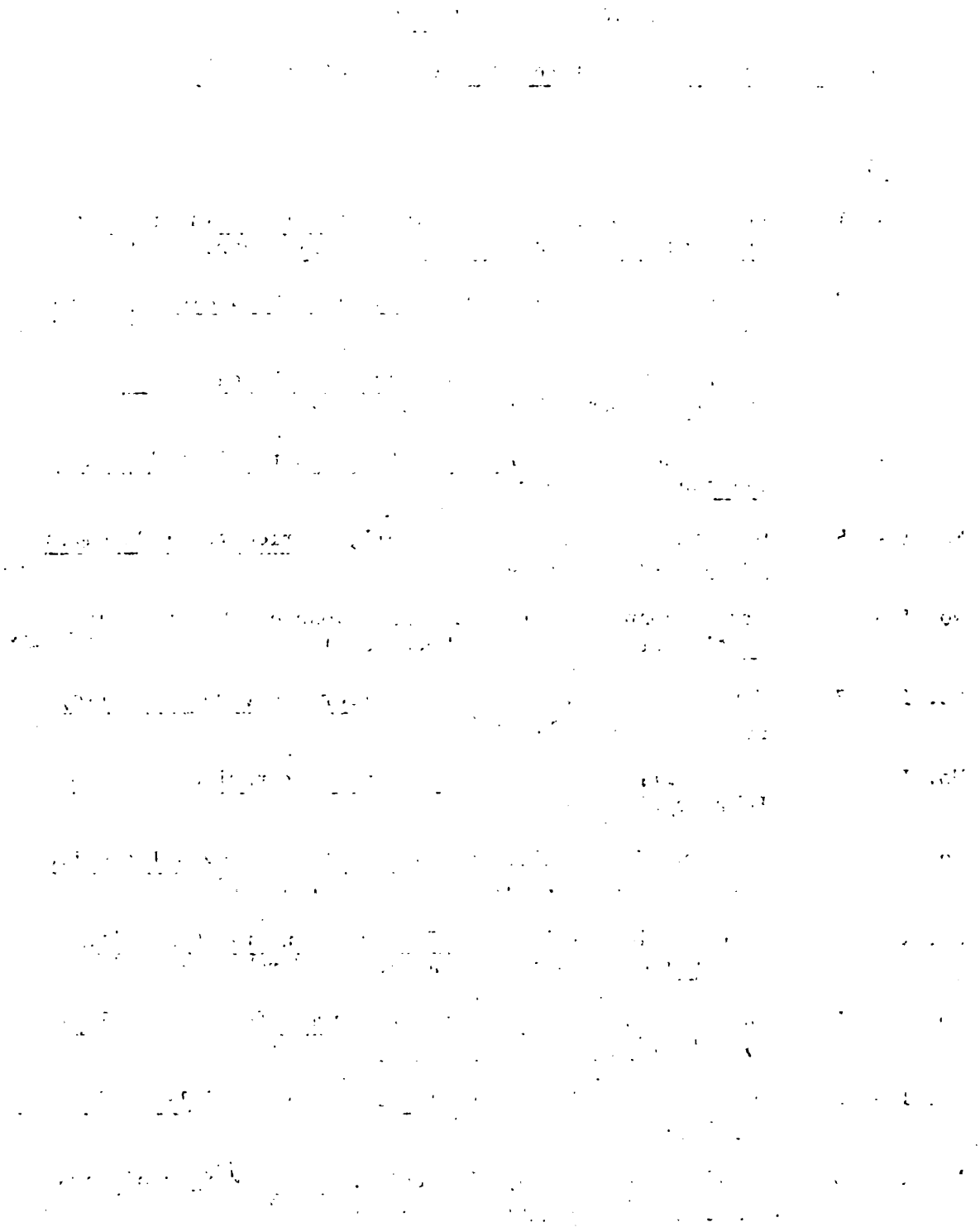

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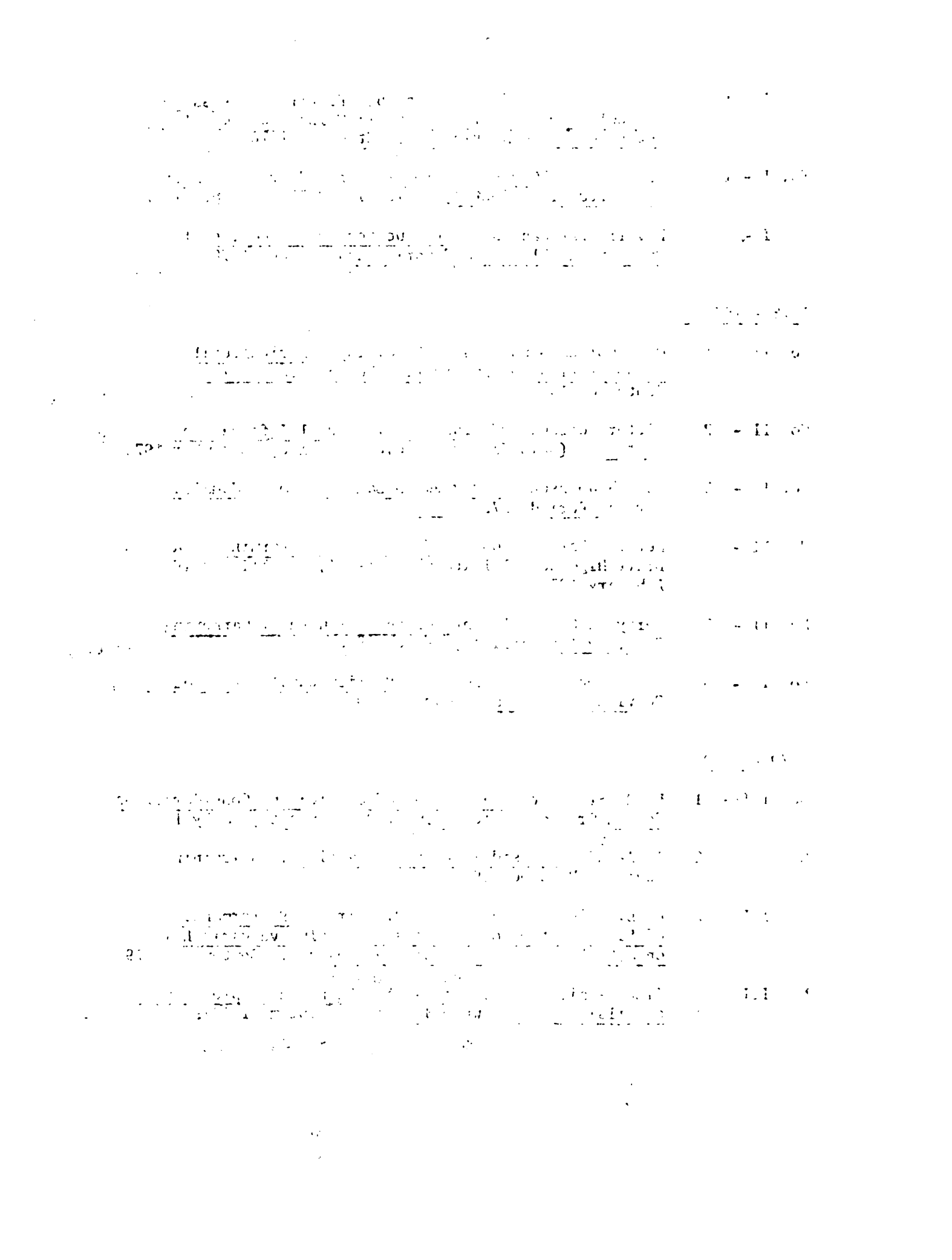

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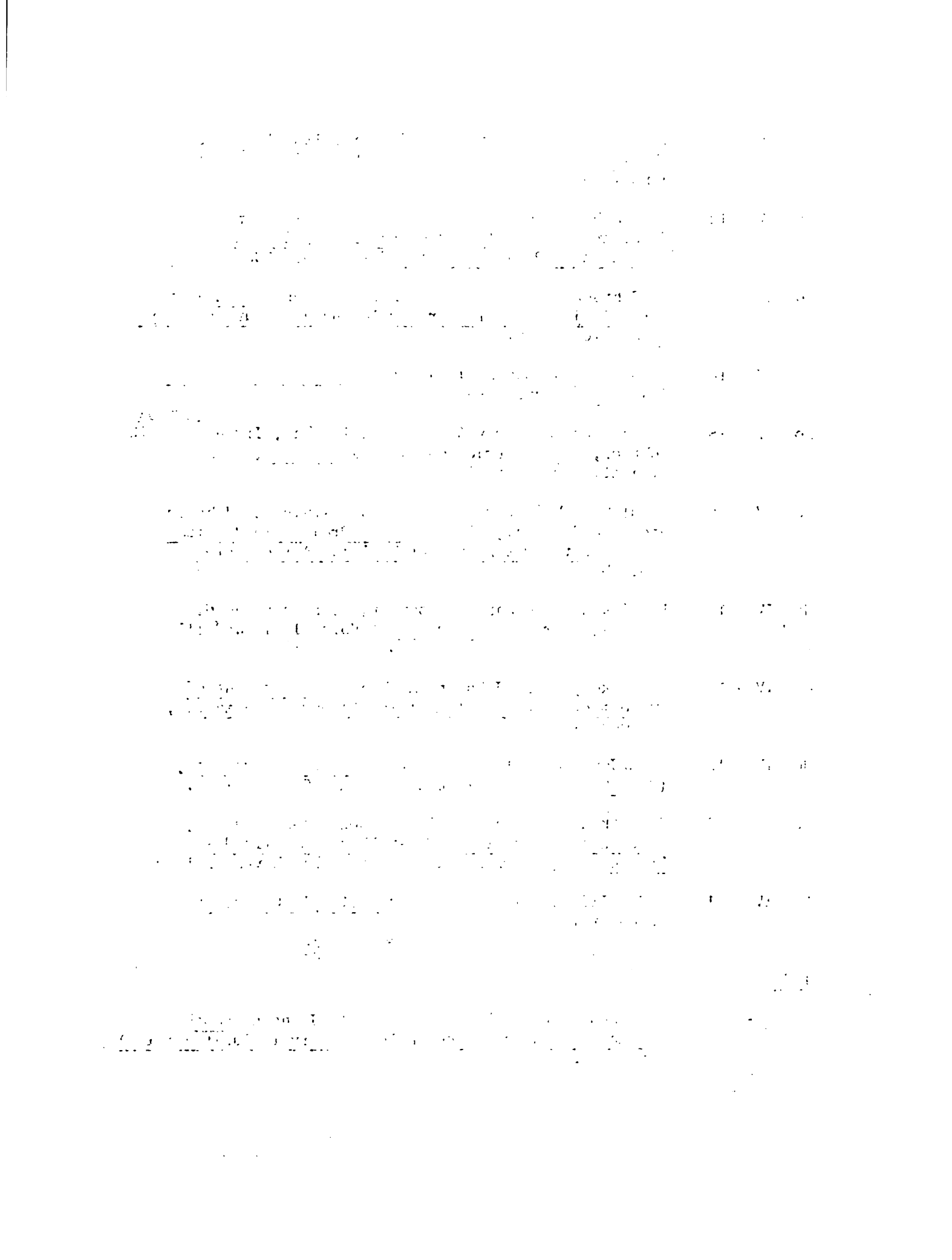

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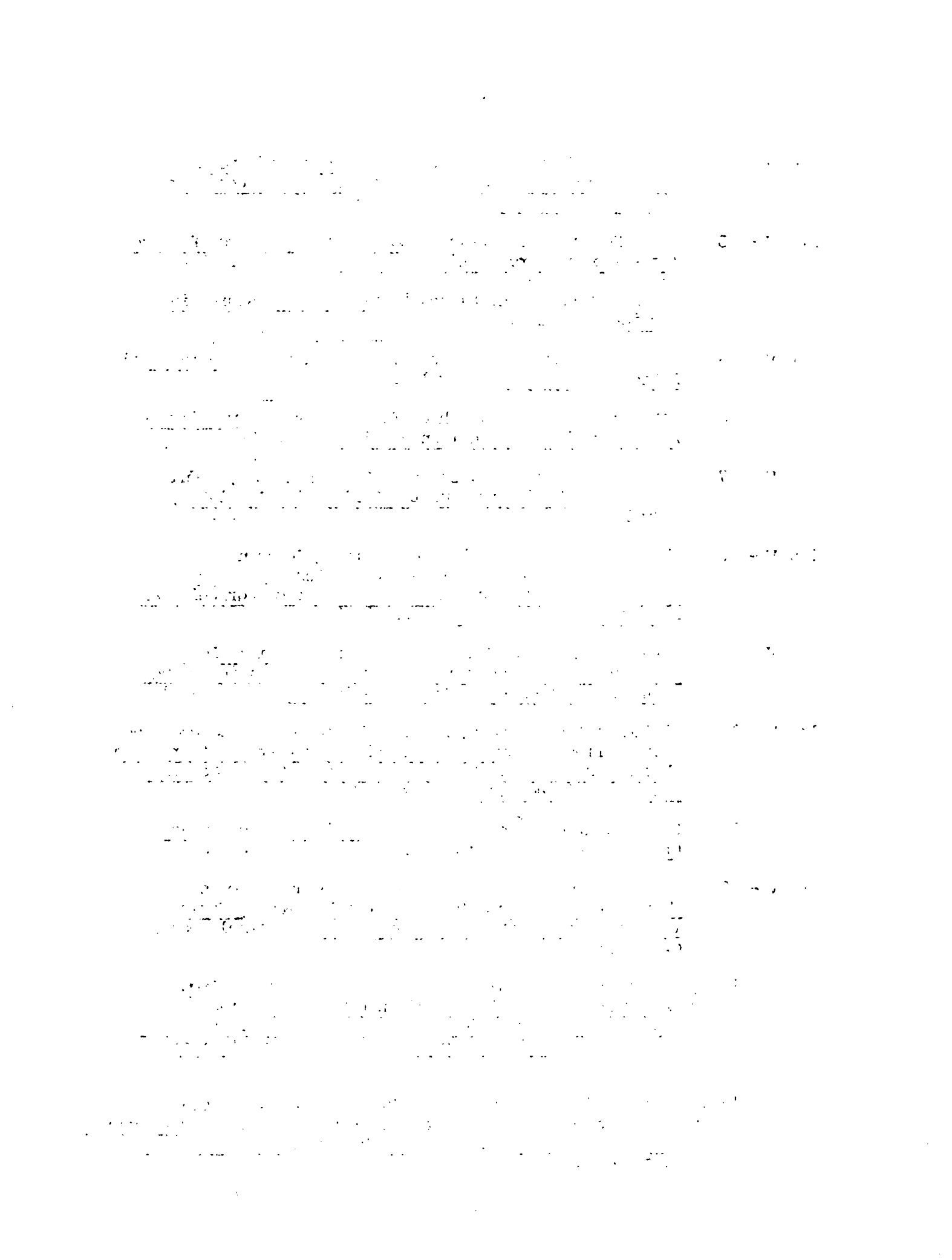

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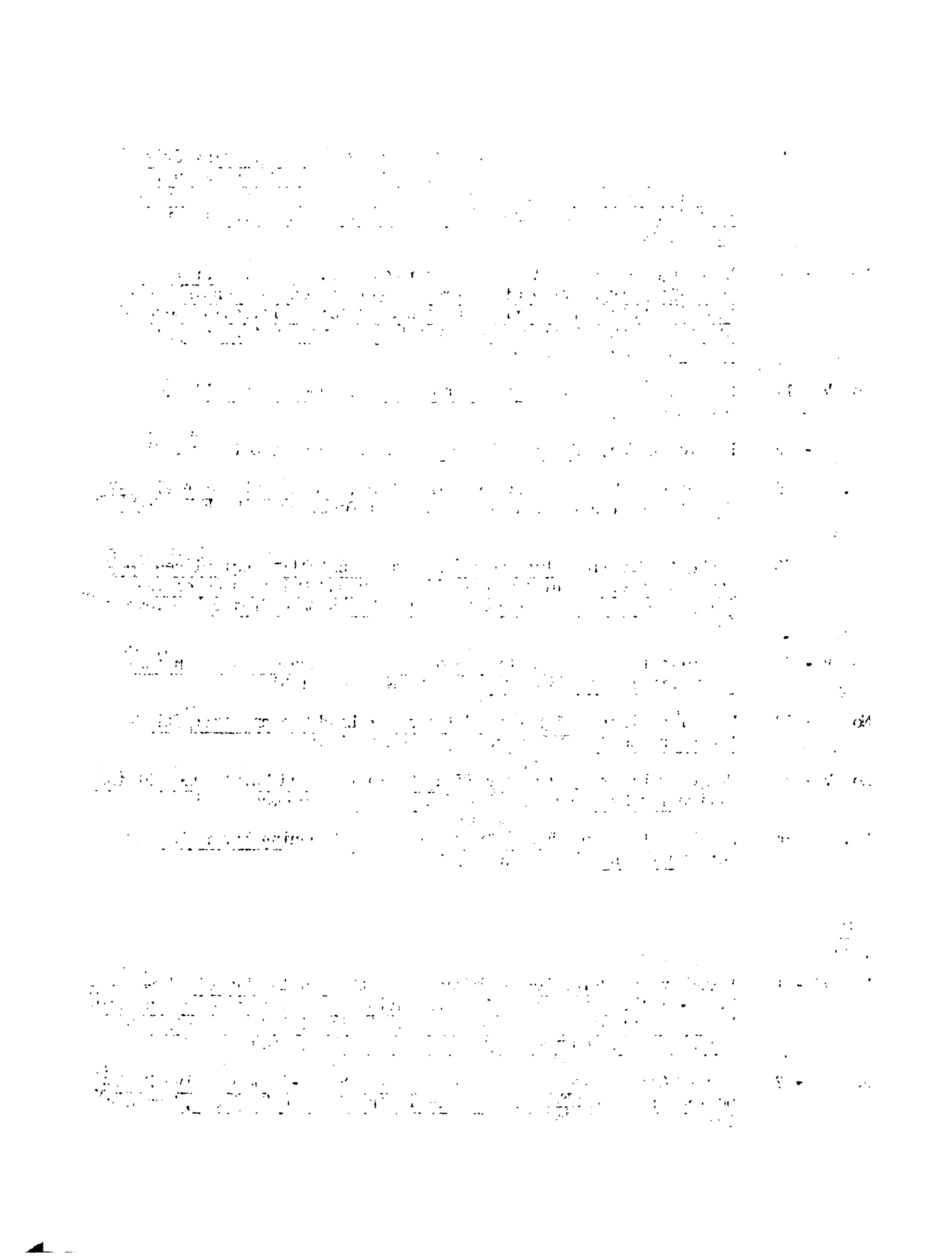

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