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Land Evaluation for rapeseed / mustard in Nagaon district, Assam

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Abstract : The soil map of Nagaon district had 24 units of family association. These soils, in general are deep to very deep, coarse loamy to fine loamy and slightly acid to neutral in reaction. The hill soils are associated with higher slope and severe erosion. The valley soils have severe limitation of flooding and poor drainage during and immediately after rainy season and therefore most of them have properties associated with aquic moisture regime. The suitability evaluation of these soil units for rapeseed and mustard indicates that 12.8 per cent of area in the uplands parts of the valley are suitable whereas 20.8 per cent is moderately suitable and 21 per cent as marginally suitable. The major soil limitations are poor drainage, acidity and poor base saturation. This study advocates the expansion of area under rapeseed/ mustard on soils which are grouped as suitable and increase cropping intensity and production.

Additional key words: Soil site suitability, rapeseed/mustard, acidity

Introduction

Rapeseed/mustard is one of the important oilseed crop in Assam and is grown over 279292 hectares, 7 per cent of total cropped area in the state. Nagaon district has an area of 22338 hectares, 8.0 per cent of total mustard area of the state with a productivity of about 660 kg ha^{-1}. There is a need to increase the productivity of rapeseed/mustard under rainfed ecosystem through soil specific management and crop selection. Though sufficiently large amount of information on blanket management practices and crop varieties are available (Assam Agricultural University and Department of Agriculture 1995), information on soil suitability and site specific management for rapeseed/ mustard is meagre. Therefore, the objective of the present study is to delineate and group soils that require similar management for rapeseed / mustard in Nagaon district.

Materials and methods

Study area

The district, Nagaon is situated between 25°45' to 26°45' N latitude and 91°50' to 93°20'E longitude. It is on the southern bank of the river Brahmaputra, 100 km east of Guwahati. The total geographical area is 3,97,000 hectares with 59.78 per cent under cultivation. The district has two distinct agro-ecological sub-regions: hot humid Brahmaputra plain, with deep loamy to clayey alluvium derived soils, medium available waterholding capacity (AWC) and length of growing period (LGP) of 240-270 days and extension of Meghalaya Plateau and Naga hills, warm to hot moist sub-humid to humid with deep loamy to clayey red and lateritic soils, medium AWC and LGP of 270-300 days (Sehgal *et al.*1992).

The mean annual rainfall varies from 1168 to 1931 mm. It is distributed mostly between 22nd and 40th standard week of the year. Rice is predominant in *kharif* (sali), *rabi* (boro) and summer (ahu) seasons and rapeseed and mustard is dominant in winter. The other important crops are jute, sugarcane, potato, wheat, blackgram and vegetable crops. Mustard is grown in winter on river channels by clearing grasses and ploughing the land for three to five times.

Soil map and soil site suitability

Soil Resource Inventory of Assam state on 1:250,000 scale was carried out and the soils were mapped as

soil family association (Sen *et al.* 1999). Suitability of land for growing rapeseed and mustard was evaluated using the guidelines given by FAO (1983). The land suitability criteria used in this study for rapeseed and mustard are presented in table 1 (Baruah *et al.* 2003) and using these criteria the soils were grouped as S1 (Suitable), S2 (moderately suitable), S3 (marginally suitable) and N (not suitable) depending on crop growth limiting characteristics of the soils.

Results and Discussion

Crop season and climate

The growing season for rapeseed and mustard commences during 42nd – 46th week (3rd week of October to 3rd Week of November) and ends up in mid January to mid February. Rapseed/mustard in the district is grown generally on stored moisture.

The analysis of 19 years of rainfall data shows that the probability of drought varies from 37 per cent at Chaparmukh to 4 per cent at Lumding. The probability of dry spell in 2nd and 3rd week of October is 41-49 per cent.

The temperature during rapeseed and mustard growing season (October-February) ranges from 15.2^{0}C to 27.4^{0}C but the minimum goes down to 9.8^{0}C in the month of January. The relative humidity ranges between 66 (February) and 81 per cent (October).

Landforms and soils

The district has three major landforms such as : (1) Hills (9% of total area), (2) Piedmont plains (30% of total area) and (3) Valleys (61% of total area).

(1) Hills : The hills are concentrated in east, south and south western parts bordering Karbi height ranging from 270 to 850 m. The hills generally are densely covered with reserve forests such as Dabaka, Lumding and Silghat. This landform has 6 soil mapping units (1 to 6 units, Table 2, Fig. 1) which differ from other soils with regard to slope (15 to 50 per cent) and drainage.

(2) Piedmont plains: These are in the southern parts of the district adjacent to the foot hills and have seven soil mapping units (7 to 13 as given in Table 2 and Fig 1) classified in the subgroups of Alfisols, Ultisols and

Table 1. Land suitability criteria for rapeseed and mustard

Land characteristics	Suitable (S1)	Moderately suitable (S2)	Marginally suitable (S3)	Not suitable (N)
Temperature (°C)	20-26	27-32	33-35	>35
		15-19	10-24	<10
Length of growing period (Days)	>95	85-95	75-84	<75
Early duration				
Medium duration	>135	120-135	110-119	<110
Late duration	>150	130-150	120-129	<120
Soil Drainage	Well	Moderately well drained	Imperfectly drained	Poorly drained
Soil reaction	6.5-7.5	5.5-6.4	4.5-5.4	<4.5
		7.6-8.5	8.6-9.0	>9.0
Effective soil depth (cm)	>100	51-100	25-50	<25
Soil texture	sl, l, sil, scl, ls	sc, cl, c, sicl	c+, s, clay >60%	
Coarse fragments (%)	< 15	15-35	36-50	>50
Soil Salinity (Electrical conductivity, dSm^{-1}) Saturation paste	< 1.0	1.1-2.0	2.1-4.0	>4.0
Exchangeable sodium per cent	<5	6-10	11-15	>15
Slope (%)	0-3	3-5	5-8	>8

Table 2. Characteristics of dominant and subdominant soils of Nagaon district

Mapping unit	Soil Taxonomy	*Area (ha)	Slope (%)	Depth (cm)	Textural family class	pH	OC (%)
				A Hills			
1	Typic Hapludalfs	9258 (2.4)	3-8	160	Fine	5.4	0.77
	Umbric Dystrudepts		30-50	130	Loamy-skeletal	5.1	1.53
2	Typic Hapludalfs	12597 (3.2)	3-8	180	Clayey	5.0	0.69
	Typic Dystrudepts		15-30	120	Loamy-skeletal	5.1	0.79
3	Typic Dystrudepts	791 (0.2)	1-3	95	Coarse-loamy	6.4	0.5
	Typic Hapludults		3-8	160	Clayey-Skeletal	5.5	0.5
4	Typic Hapludalfs	1012 (0.3)	3-8	160	Fine	5.3	0.77
	Ultic Hapludalfs		8-15	150	Fine	5.0	0.55
5	Dystric Eutrudepts	694 (0.2)	0-1	120	Fine	6.0	0.53
	Mollic Hapludalfs		3-8	160	Fine	5.5	0.55
6	Aeric Haplaquepts	8951 (2.3)	<1	72	Fine	5.5	1.37
				II.Piedmont plains			
	Typic Haplaquepts		0-1	122	Fine-loamy	6.4	1.03
7	Aquic Udifluvents	18533 (4.7)	0-1	100	Coarse-loamy	6.0	0.75
	Typic Haplaquepts		0-1	122	Fine-loamy	6.4	1.03
8	Typic Udifluvents	3772 (0.96)	1-3	105	Fine loamy	6.3	0.59
	AquicDystric Eutrudepts		0-1	120	Fine-loamy	6.0	0.59
9	Aquic Dystric Eutrudepts	34055 (8.7)	1-3	147	Clayey	6.5	1.07
	Dystric Eutrudepts		0-10	120	Fine-silty	5.7	0.75
10	Typic Hapludalfs	19492 (5.0)	3-8	157	Coarse loamy	6.6	0.55
	Ruptic Alfic Eutrudepts		15-30	120	Fine	5.1	1.09
11	Typic Dystrudepts	34836 (8.9)	1-3	105	Fine-loamy	6.3	0.60
	Typic Hapludults		3-8	160	Clayey soil	5.5	0.55
12	Umbric Dystrudepts	2848 (0.73)	1-3	140	Fine-loamy	4.9	1.16
	Typic Hapludults		3-8	180	Clayey	5.0	0.65
13	Aeric Haplaquepts	2682 (0.68)	0-1	135	Fine	6.2	0.71
	Aeric Udifluvents		0-1	100	Coarse-loamy	6.6	0.43
				B.Valley			
				III.Uplands			
14	Aeric Haplaquepts	15810 (4.0)	1-3	125	Fine-silty	6.5	0.58
	Aeric Haplaquepts		1-3	120	Coarse-loamy	6.4	0.73
15	Aeric Haplaquepts	80254 (20.5)	0-1	120	Fine-silty	6.6	0.58
	Dystric Fluvaquentic Eutrudepts		1-3	121	Coarse-loamy	6.1	0.74

Cont.

			IV. Flood plains				
16	Aeric Fluvaquents	16309 (4.2)	0-1	135	Fine-loamy	6.2	0.89
	Aeric Haplaquepts		0-1	120	Coarse-loamy	6.1	0.78
17	Typic Fluvaquents	15546 (4.0)	0-1	64	Coarse-loamy	6.1	0.68
	Dystric Eutrudepts		1-3	150	Fine-loamy	6.8	1.03
18	Mollic Udifluvents	10442 (2.79)	0-1	173	Coarse-loamy	6.1	1.16
	Typic Haplaquepts		0-1	122	Fine-loamy	6.4	1.03
19	Typic Udifluvents	50518 (13.0)	0-1	100	Coarse-silty	6.7	0.43
	Typic Fluvaquents		0-1	64	Coarse-loamy	6.1	0.68
20	Typic Udifluvents	8789 (2.2)	1-3	120	Fine-loamy	6.4	0.37
	Dystric Eutrudepts		0-1	125	Coarse-silty	6.2	0.81
21	Aquic Udifluvents	2663 (0.7)	1-3	105	Coarse-silty	5.7	1.04
	Typic Haplaquents		<1	102	Fine-loamy	5.9	0.40
22	Typic Kanhapluhumults	7756 (2.0)	3-8	180	Fine	5.0	0.68
	Typic Dystrudepts		1-3	105	Fine-loamy	6.3	0.60
23	Ruptic Ultic Dystrudepts	16220 (4.1)	15-30	120	Fine	5.1	1.09
	Typic Udorthents		8-15	120	Loamy-skeletal	5.8	1.90
24	Typic Hapludalfs	16844 (4.3)	3-8	210	Fine-loamy	6.2	0.49
	Typic Hapludalfs		3-8	157	Coarse-loamy	6.5	0.56

*The figures in parenthesis are per cent of total geographical area of the distict

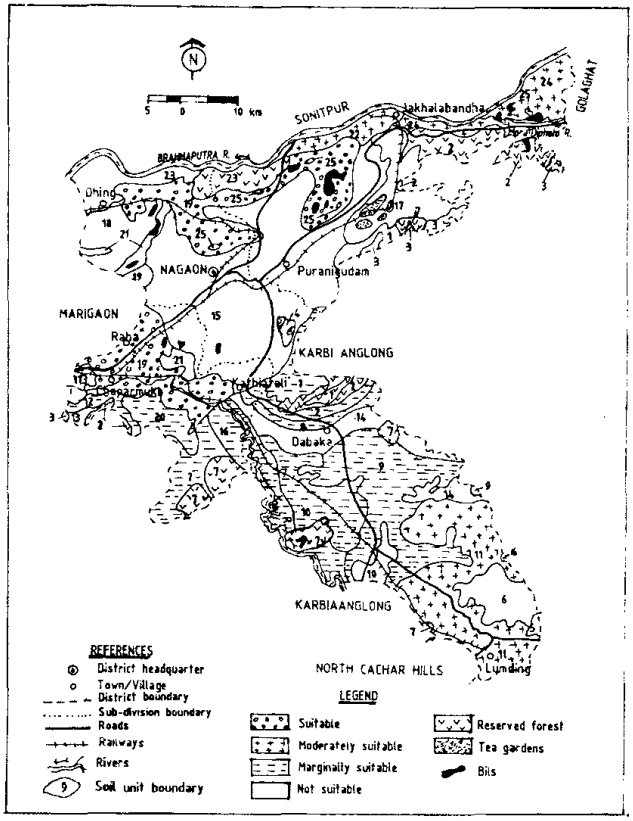

Fig. 1. Soil site suitability for Rape seed and Mustard in Nagaon district.

Inceptisols. These are mostly cultivated to paddy and pulses. The soils with aquic moisture regime (unit 7, 8 and 13) occur where slopes are flat or very gently sloping.

(3) Valleys: This unit is further divided into upland plains (24.5 per cent of total area) and flood plains (37.0 per cent of total area). It is in the northern parts where the Brahmaputra flows and deposits huge quantity of silt and sand. These lands are mostly covered with grasses with patches of cultivation.

The upland in the plains has two soil mapping units (14 and 15) which belong to Aquic Dystric Eutrudepts, Typic Udifluvents and Aeric Udifluvents (Table 2). The flood plains have 9 soil mapping units (16 to 24) grouped in Aquic Dystric and Dystric Eutrudepts, Aeric Haplaquepts, Aeric Haplaquents, Typic Fluvaquents, Typic Udifluvents, Mollic Udifluvents, Typic Haplaquepts and Fluventic Eutrudepts. These soil units are flat with 0-1% slope and therefore have drainage and flooding problems.

Soil characteristics

The soil characteristics used for assessing suitability for rapeseed/mustard include soil depth, surface texture, soil reaction, drainage, soil erosion and available water holding capacity. In general, the soils in Nagaon district are very deep which cover an area of 3,90,681 hectares (99.65 per cent). The surface texture in 87 per cent area is coarse loamy or fine loamy. Clay soils are noticed over 13.1 per cent area in Raha and Hojai. Ninety two per cent soils are slightly acid to neutral. The drainage in the valley portions is poor in the rainy season and improves in the winter as water table starts receeding gradually below the root zone. The poorly drained soils cover 30 per cent of area followed by imperfectly drained (26.3 per cent) and moderately well drained (22.6 per cent). The soils of the hills are severely to moderately eroded and such soils cover 25.6 per cent of the total area. They have medium to high available water holding capacity (Table 2).

Soil site suitability for rapeseed/mustard

The soil resource information have been used in many land evaluation excercises at district level for several crops. Evaluation for the cotton based cropping systems in Adilabad district (Bhaskar *et al.* 2000) and for rice based cropping systems in Jorhat district, Assam (Vadivelu *et al.*2003) are some examples. Similar kind of crop geography analysis is attempted in this paper to identify the suitable soil units for further expansion of area under rapeseed/ mustard in the region. The suitability of soil units was decided by the most limiting soil and site characteristics.

The 24 soil mapping units are defined and depicted in soil map (Fig.1). The soil units in hill ranges (1 to 6), marshy and bil lands and tea gardens are excluded from land evaluation exercise because of severe limitations of vegetation clearance, erosion and flooding hazards. The soil units are grouped into four categories as (i) suitable (S1), (ii) moderately suitable(S2), (iii) marginally suitable(S3) and (iv) not suitable and these classes are depicted in the suitability map (Fig.1) and in table 3.

The suitable land units (S1 class) cover 50518 hectares (12.8 per cent total area) and are mainly confined to flood plains and uplands in Assam valley. The dominant soil associations are fine-loamy, mixed, Aeric Fluvaquents and coarse-loamy, mixed, Aeric Haplaquepts. The soils are very deep, well drained during post rainy season as water table drops below 2 m, coarse-loamy, neutral with 0.43 to 0.68 per cent organic carbon content. These land units are concentrated in the area between national highway and Brahmaputra river.

Moderately suitable land units cover an area of 82700 hectares (20.8 per cent of total area) and concentrated mostly in north eastern, southern and south western parts of the district. The soil units grouped in this suitability category are 8, 10 and 11 piedmont plains and 22 and 24 of flood plains. The soils are dominantly coarse-loamy, mixed, Aquic Udifluvents, coarse-loamy mixed Typic Hapludalfs and fine-loamy/coarse-loamy, mixed Typic Udifluvents. Strong to moderate acidity and low base saturation (<35%) are the soil limitations for growing mustard. Although the soils on piedmont plains are moderately suitable, the probability of occurrence of 2 weeks of dry spell during October is 41-49 per cent. Hence, one or two irrigations are required to save the crop. In the rain shadow area between North Cachar and Karbi- Anglong hills the cole crops and pulses like black gram and green gram are preferred over rapeseed and mustard.

Marginally suitable (S3 class) lands cover an area of 83197 hectares (20.95%). This class includes 10 soil mapping units concentrated mainly in south and north western and eastern parts of the district. The soils are fine/ fine loamy, mixed Aeric/Typic Haplaquepts (Table 3). The soil map unit 16 covers 4.16 per cent area in the flood plains and has fine/fine-silty, mixed, Aquic Dystric Eutrudepts. It is occasionally subjected to seasonal flooding during October-November, thereby wetness is severe limitation for the crop growth.

The flood plains in the central part of the district is evaluated as unsuitable for rapeseed and mustard because of flooding and poor drainage. This unit covers an area of 140954 hectares (35:5 per cent of total area).

Table 3. Soil site suitability analysis of Nagaon soils for rapeseed/mustard

Mapping unit	Dominant/subdominant	Slope	Drainnage	Gravel	Depth	Texture	pH	Suitability
			II. Piedmont plains					
7	Coarse-loamy Aquic Udifluvents	S1	S3	S1	S1	S1	S2	S3fw
	Fine-loamy Typic Haplaquepts	S1	S2	S1	S1	S1	S2	S2fw
8	Coarse-loamy Typic Udifluvent	S1	S2	S1	S1	S1	S2	S2fw
	Fine-loamy Aquic Dystric Eutrudepts	S1	S2	S1	S1	S1	S2	S2fw
9	Fine Aquic Dystric Eutrudrepts	S1	S3	S1	S1	S3	S1	S3wsf
	Fine-silty Dystric Eutrudrepts	S1	S3	S1	S1	S2	S2	S3wsf
10	Coarse-loamy Typic Hapludalfs	S2	S2	S1	S1	S1	S1	S2ftw
	Fine Ruptic Alfic Eutrudepts	N1	S1	S2	S1	S2	S3	N1tfs
11	Fine-loamy Typic Dystrudepts	S1	S1	S1	S1	S1	S2	S2f
	Clayey Typic Hapludults	S2	S1	S1	S1	S2	S3	S3ft
12	Fine-loamy Umbric Dystrudepts	S1	S1	S1	S1	S1	S3	S3f
	Clayey Typic Hapludults	S2	S1	S1	S1	S2	S3	S3fts
13	Fine-loamy Aeric Haplaquepts	S1	N1	S1	S1	S1	S2	N1wf
	Coarse-loamy Aeric Udifluvents	S1	N1	S1	S1	S1	S1	N1wf
			III. Uplands					
14	Fine-silty Aeric Haplaquepts	S1	N1	S1	S1	S2	S2	N1wfs
	Coarse-loamy Aeric Haplaquents	S1	N1	S1	S1	S1	S2	N1wfs
15	Fine-silty Aeric Haplaquepts	S1	N1	S1	S1	S2	S2	N1wfs
	Coarse-loamy Dystric Fluvaquentic Eutrudepts	S1	S3	S1	S1	S1	S2	S3fw
			IV. Floodplains					
16	Fine-loamy Aeric Fluvaquents	S1	S3	S1	S1	S1	S2	S3wf
	Coarse-loamy Aeric Haplaquepts	S1	S2	S1	S1	S1	S2	S2fw
17	Coarse-loamy Typic Fluvaquents	S1	N1	S1	S2	S1	S2	N1wfs
	Fine-loamy Dystric Eutrudepts	S1	S1	S1	S1	S1	S1	S1
18	Coarse-loamy Mollic Udifluvents	S1	N1	S1	S1	S1	S2	N1wf
	Fine-loamy Typic Haplaquepts	S1	S2	S1	S1	S1	S2	S2fw
19	Coarse-silty Typic Udifluvents	S1	S1	S1	S1	S1	S1	S1
	Coarse-loamy Typic Fluvaquents	S1	S2	S1	S2	S1	S2	S2fws
20	Fine-loamy Typic Udifluvents	S1	S3	S1	S1	S1	S2	S3wf
	Coarse-silty Dystric Eutrudepts	S1	S1	S1	S1	S1	S2	S2f
21	Coarse-silty Aquic Udifluvents	S1	S3	S1	S1	S1	S2	S3wf
	Fine-loamy Typic Haplaquents	S1	S3	S1	S1	S1	S2	S3fw
22	Clayey-Typic Kanhapluhumults	S2	S1	S1	S1	S2	S3	S3fst
	Fine-loamy Typic Dystrudepts	S1	S1	S1	S1	S1	S2	S2f
23	Fine Ruptic Ultic Dystrudepts	N1	S1	S3	S1	S2	S3	N1tsf
	Loamy-skeletal Typic Udorthents	N1	S1	S1	S1	S1	S2	N1tf
24	Fine-loamy Typic Hapludalfs	S2	S1	S1	S1	S1	S2	S2ft
	Coarse-loamy Typic Hapludalfs	S2	S1	S1	S1	S1	S1	S2t

Conclusion

Presently the district Nagaon has mustard over an area of 22338 ha. The appraisal of land resources for rapeseed/ mustard clearly shows that nearly 50518 ha is suitable. Therefore, there is a scope to double the area under these crops immediately based on the soil potentials. This will improve the cropping intensity and compensate crop loss in times of floods.

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