

## Symptom diversity due to infection by different isolates of *Alternaria brassiaca* on Rapeseed and Mustard in Assam

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**Abstract:** Diagnostic symptoms of *Alternaria* blight of rapeseed and mustard which is one of the destructive disease of Assam were observed in the field conditions starting from initiation of spot on the seedlings, on leaves, stems, pods and seeds. Dark black leafspot of the disease which initially appeared on the leaves soon increased in size and remained light to dark brown with conspicuous black concentric rings at the centre with target board is the most typical symptom to identify the *Alternaria* blight disease. Symptomatological variations on numbers and size of spots, presence and absence of concentric rings, numbers of concentric rings, presence of yellow halo on leaves and pods of forty isolates of *Alternaria* blight of rapeseed and mustard varied on six different geographical locations of Assam. The average size of the spot on leaves of the isolates in LBVZ ranged between 32.78mm to 53.67mm, while in NBPZ it was 29.67mm to 57.78mm. In CBVZ it was 15.56mm to 32.45mm while in UBVZ it was 37.65mm to 50.76mm. In HZ and BVZ the average size of spots on leaf was 26.65mm and 40.54mm respectively. The average numbers of spots on leaf on LBVZ, NBPZ, CBVZ ranged between 15-100, 8-30, 9-11, 16-105 respectively. In HZ and BVZ, the average numbers of spots were 107 and 20 respectively. In case of pods, the average size ranged from 5.67mm to 13.79mm, 12.78mm to 17.78mm, 9.78mm to 45.56mm, 12.56mm to 32.34mm, 12.56mm to 16.76mm in LBVZ, NBPZ, CBVZ, UBVZ and HZ, respectively. Colours of spots on leaves were light brown, brown, dark brown and orange brown while on pods it was dark brown, blackish brown and light brown. Concentric rings and yellow halo zones were present in most of the isolates.

**LBVZ:** Lower Brahmaputra Valley Zone, **CBVZ:** Central Brahmaputra Valley Zone, **NBPZ:** North Bank Plain Zone, **HZ:** Hill Zone, **BVZ:** Barak Valley Zone, **UBVZ:** Upper Brahmaputra Valley Zone

**Key words:** *Alternaria*, Rapeseed and mustard, Assam, Agroclimatic zone, spots, LBVZ, UBVZ, NBPZ, CBVZ, BVZ, HZ,

### INTRODUCTION

India is said to be the paradise for oilseed crops accounting as fourth largest oilseed producing country in the world (Jha *et al.*, 2012). Among different oilseeds, rapeseed and mustard alone contributes 32.00 per cent of total oilseed production in India (Jha *et al.*, 2012). In 2012-13, total production was 78.20 lakh tones with an area of 6.92m ha and yield of 1307kg/ha while in 2013-14, it was targeted to produce 74.90 lakh tones with an yield of 1147kg/ha (ASD, 2013), thus playing a pivotal role in agricultural economy of the country. The production of Rapeseed and Mustard in our country has been increasing in the last few years. But despite considerable increase in the productivity and production of the oilseed, a wide

gap is found to exist between the potential yield and the yield realized at the farmer's field, which is largely because of a number of biotic and abiotic stresses to which it is exposed. Among the biotic stressors, *Alternaria* blight (*Alternaria* spp.), causes a major problem in production (Reddy, 2009). India is facing serious yield and quality loss in production due to this pathogen (Sharma *et al.*, 2013). *Alternaria* blight disease caused by *Alternaria* spp. has been reported from all the continents of the world and is one among the important diseases of the crop in India causing up to 47.00 per cent yield losses (Kolte, 1985). Saharan, 1992; and Kolte, 2002 reported that *Alternaria* blight sometimes causes more severe losses (up to 70.00%) in rapeseed (*Brassica campestris*). The typical symptom

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of *A. brassicae* is characterized by the formation of small, brown to dark colored spots on leaf which rapidly expand to form circular lesions up to 1 cm in diameter. Sometimes concentric ring formation takes place. Later on, the lesions get coalesce leading to complete drying of the leaves, blackening of stem and silique, thus resulting in blighted conditions (Valkonen and Koponen, 1990; Meena *et al.*, 2010).

In most of the areas of Assam, rapeseed and mustard is cultivated as sole crop with an objective of producing edible oil. However, in Assam, despite its importance, the disease has not been adequately studied. Although symptom variability is observed under field conditions, no study on symptomatology, and its symptomatological diversity by different isolates has under the prevailing climatic conditions of Assam. Considering the paucity of information on above mentioned aspects, the present work was conducted.

## MATERIALS AND METHODS

### Diagnostics symptoms of Rapeseed and Mustard in field conditions in ICR farm, AAU, Jorhat

Symptomatological studies were done at all the growth stages of the crop right from seedling stage to the maturity stage on leaves, stem and pods. Data

was recorded starting from initiation of the conspicuous black spot to the complete drying of the leaves and pods in the experimental field of ICR farm.

### Symptomatological observations of forty isolates of *Alternaria brassicae* from six Agroclimatic zones of Assam

Symptomatological studies on all the collected forty isolates were done using the following parameters on leaves and pods. The parameters were number of spots, size of spots, colour of spots, presence and absence of concentric rings, number of concentric rings and presence of yellow halo on leaves and pods.

### Collection of the samples from different Agroclimatic zones of Assam

Forty isolates of *Alternaria brassicae* from different pockets of Six agroclimatic zones of Assam (Table 1, Fig. 1) were collected and brought to the laboratory of Department of Plant Pathology, AAU, within seven days of collection.

## RESULTS AND DISCUSSION

### Diagnostic symptoms of Rapeseed and Mustard in field conditions in ICR farm, AAU, Jorhat

*Alternaria* blight is an important disease of Rapeseed and Mustard. Characteristic symptoms observed in

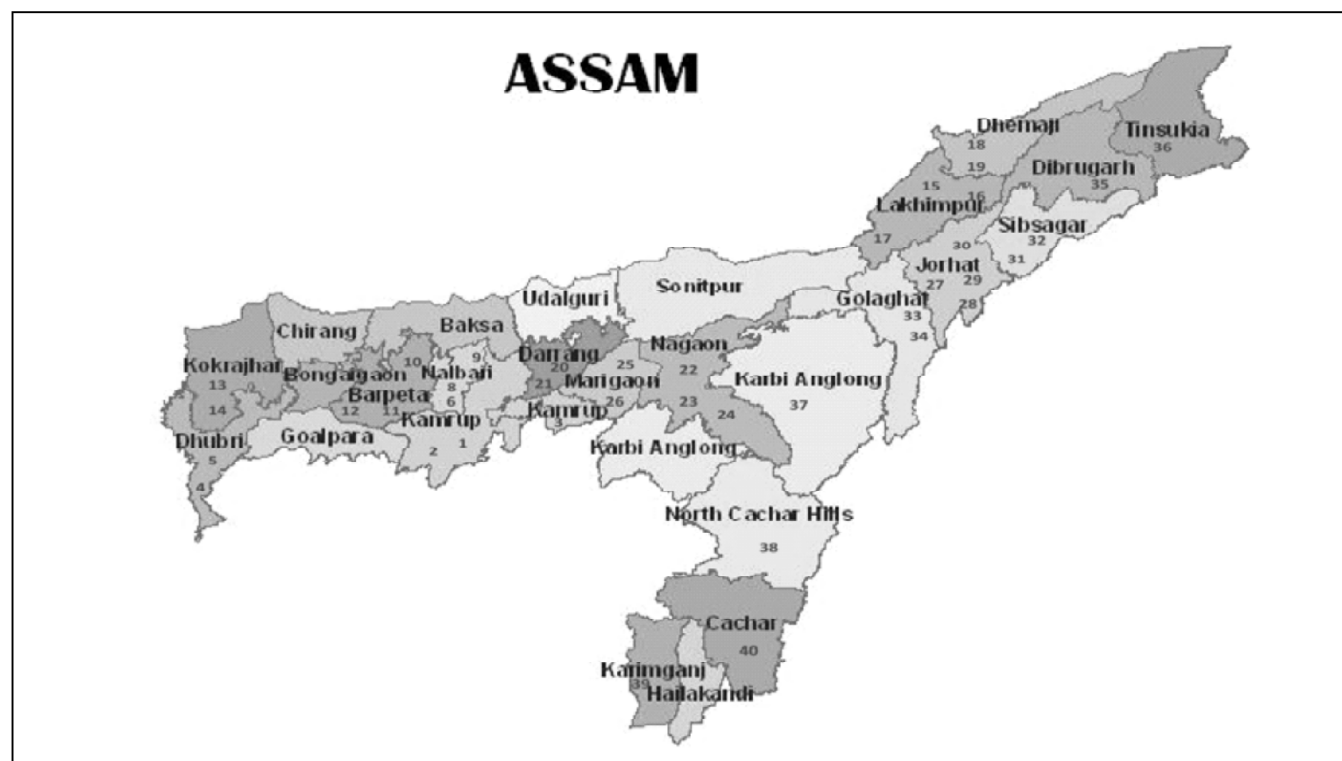


Figure 1: *Alternaria brassicae* isolates collected from different pockets of Assam

**Table 1**  
**Isolates *Alternaria brassicae* collected from different pockets of six Agro climatic Zones of Assam**

<i>Districts</i>	<i>Pockets</i>	<i>Isolates name</i>	<i>Latitude</i>	<i>Longitude</i>
Lower Brahmaputra Valley Zone (LBVZ)				
Kamrup	Kahikuchi	Is 1_Kam	26.3588° N	91.1329° E
	Boko	Is 2_Kam	25.9778° N	91.2356° E
	Hajo	Is 3_Kam	26.2519° N	91.5257° E
Dhubri	Bilasipara	Is 4_Dhu	26.2300° N	90.2300° E
	Mancachar	Is 5_Dhu	25.5300° N	89.8700° E
Nalbari	Belshor	Is 6_Nal	26.3981° N	91.3638° E
	Goreshwar	Is 7_Nal	26.5400° N	91.7300° E
	Kamarkuchi	Is 8_Nal	26.0856° N	91.8537° E
	Tihu	Is 9_Nal	26.4749° N	91.2689° E
Barpeta	Pathshala	Is 10_Bar	26.4994° N	91.1793° E
	Bahari	Is 11_Bar	26.2546° N	91.1379° E
	Baradi	Is 12_Bar	26.3274° N	91.0507° E
Kokrajjar	Gossaigaon	Is 13_Kok	26.4197° N	89.9842° E
	Salakati	Is 14_Kok	26.4933° N	90.3625° E
North Blank Plain Zone (NBPZ)				
Lakhimpur	Ghalimora	Is 15_Lak	26.4400° N	92.3456° E
	Dhokuwakhana	Is 16_Lak	27.2300° N	94.1000° E
	Narayanpur	Is 17_Lak	26.9964° N	93.8969° E
Dhemaji	Gogamukh	Is 18_Dhe	27.4303° N	94.3102° E
	Bordoloni	Is 19_Dhe	26.8022° N	93.5635° E
Darrang	Machkhowa	Is 20_Dar	26.1779° N	91.7374° E
	Norowathan	Is 21_Dar	27.2861° N	94.4449° E
Central Brahmaputra Valley zone (CBVZ)				
Nagaon	Shillongoni	Is 22_Nag	26.3503° N	92.6922° E
	Raha	Is 23_Nag	26.2327° N	92.5278° E
	Mikirgaon	Is 24_Nag	26.1407° N	92.6933° E
Morigaon	Mayong	Is 25_Mor	26.2589° N	92.0408° E
	Banmurigaon	Is 26_Mor	26.4800° N	90.5600° E
UpperBrahmaputra Valley zone (UBVZ)				
Jorhat	Titabor	Is 27_Jor	26.6000° N	94.2000° E
	Teok	Is 28_Jor	26.8130° N	94.4065° E
	AAU , ICR farm	Is 29_Jor	26.4400° N	94.0000° E
	Majuli	Is 30_Jor	26.9500° N	94.1667° E
Sivsagar	Dimow	Is 31_Siv	27.1268° N	94.7400° E
	Amguri	Is 32_Siv	26.5800° N	94.5230° E
Golaghat	Dergaon	Is 33_Gol	26.7000° N	93.9700° E
	Borpothar	Is 34_Gol	27.4728° N	94.9119° E
Dibrugarh	Sarupathar	Is 35_Dib	26.1946° N	93.8629° E
Tinsukia	Doom Dooma	Is 36_Tin	27.5700° N	95.5700° E
Hill Zone (HZ)				
KarbiAnglong	Badarpur	Is 37_Kar	24.9000° N	92.6000° E
North Cachar Hill	Haflong	Is 38_NC	25.1800° N	93.0300° E
Barrak Valley Zone (BVZ)				
Karimgang	Diphu	Is 39_Kar	25.8300° N	25.8300° N
Cachar	Silchar	Is 40_Cac	24.8200° N	24.8200° N

rapeseed and mustard under natural field conditions were as follows:-

*Alternaria* blight symptoms appears initially on the lower leaves of the *Brassica* plants, as minute black dots on the seedling stage (Plate 1a, 1b). Dark black leaf spot of *A. brassicae* (Berk.) Sacc soon increased in size from 0.5 to 12.0 mm and remained light to dark brown with conspicuous black concentric rings at the centre with target board which is a typical symptom to identify the *Alternaria* blight disease (Plate 1c, 1d). The symptoms later spread from lower leaves to the upper leaves and covered the entire plant. The closely

situated spots on each leaf of the plant coalesced and covered the entire leaf surface with blighted appearance and with advance of time the whole leaf got dried (Plate 1e, 1f, 1g). Round black conspicuous spots appeared on stem and slowly got enlarged (Plate 1h, 1i).

On pod, it was dark black dots which later became circular to oval, rarely linear, with grayish white centre. Later on, the disease spread to all the pods in the whole plant. In severe condition, the whole pod got dried (Plate 1j, 1k). In severe cases, the disease was observed to cause premature drying, shrinkage

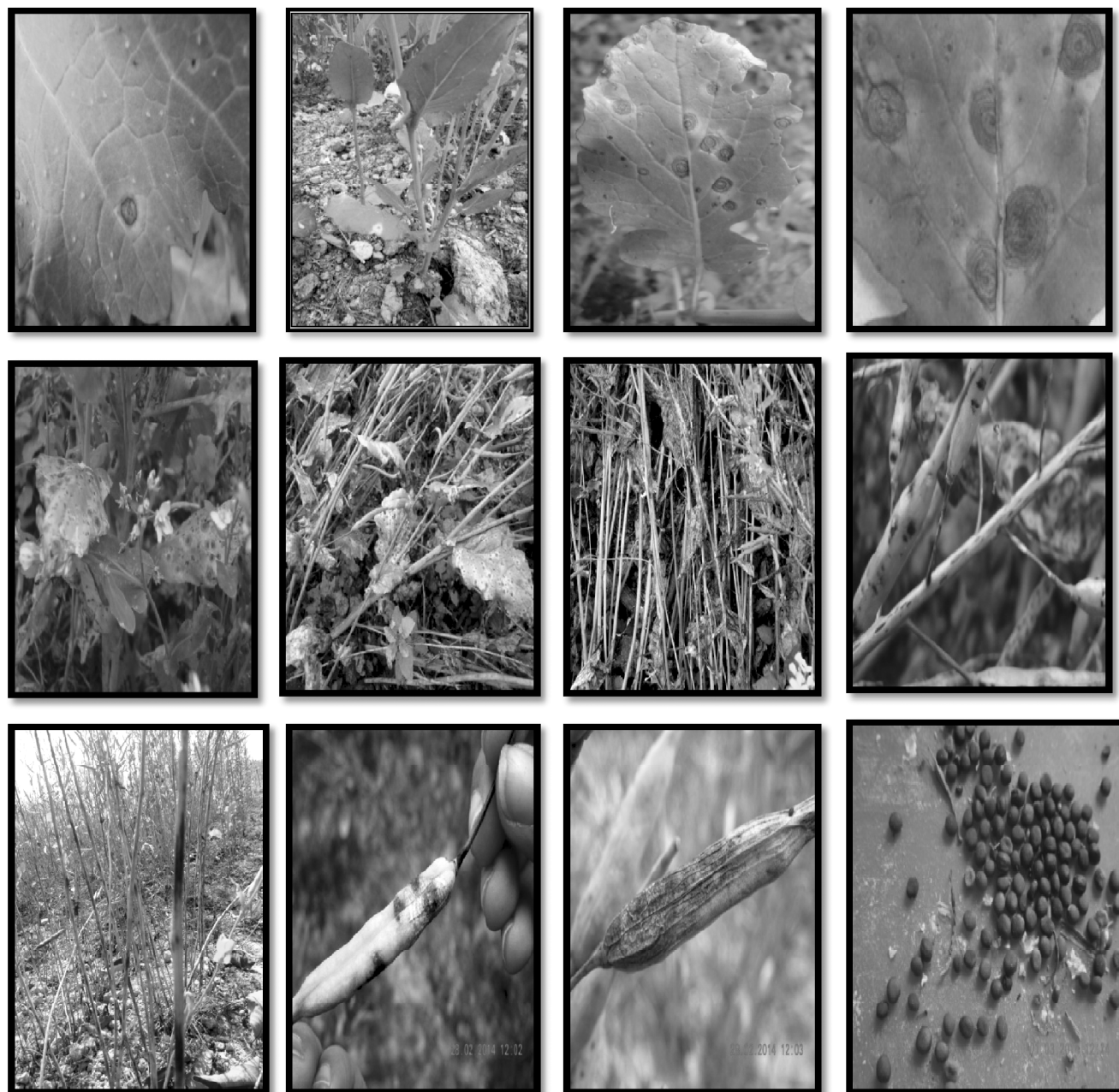


Plate 1 (a-l): Diagnostics symp toms of *Alternaria* blight on leaves, stems, pods and seeds

and shattering of pods. The seeds inside the severely infected pod did not develop properly and developed a shriveled texture with gray colour (Plate II).

The results were in accordance with Meena *et al.* (2010). According to them, symptoms of *Alternaria* blight were characterized by formation of spots on leaves, stem and pods. Gray to dark color spots appeared on the lower leaves which gradually enlarged and then spread to upper leaves of the plant. Elongated lesions appeared on the stems as well as on pods, thereby producing premature ripening and shedding of deformed pods. Similar types of symptoms were also reported by Sangwan and Mehta (2007), Meena *et al.* (2012) and Jha *et al.* (2013) on rapeseed and mustard and Selvamani *et al.* (2014), found similar symptoms on cauliflower, cabbage and mustard growing areas of different geographical locations of India.

#### **Symptomatological observations of forty isolates of *Alternaria* spp. from six Agro-climatic zones of Assam**

Data presented in Table 2, demonstrates symptomatological observations of forty isolates of *Alternaria* spp. from six Agro-climatic zones of Assam in respect of six qualitative characters i.e. number of spots, average size of spots, colour of spots, presence of concentric rings, average number of concentric rings and presence of yellow halo on leaves and pods.

In Lower Brahmaputra Valley Zone, average number of spots on leaf ranged from 15 to 100, average size ranged from 32.78 to 53.67mm, exhibited varied colours of spots like light brown, brown, dark brown and orange brown on leaves, most of the spots developed concentric rings with average number ranging from 2 to 15. While in pods the number of spots ranged from 12 to 50, size ranged from 5.67 to 13.79mm and exhibited dark brown, blackish brown and light brown and Isolate Is 7\_Nal developed 3 concentric rings. Most of the spots on the leaves possessed yellow halo around it.

In North Bank Plain Zone, average number of spots on leaf ranged from 8 to 30, average size ranged from 29.67 to 57.78mm, exhibited two colors of spots like brown and orange brown on leaves, most of the spots developed concentric rings and average number ranged from 4 to 17. While in case of pod, Isolate Is 17\_Nal exhibited 13 spots with average size of 17.78mm with blackish brown colour while in Isolate Is 20\_Dar, number of spots and average size was 5 and 12.78mm with blackish brown colour. Only Isolate Is 16\_Lak possessed yellow halo on the leaf.

In Central Brahmaputra Valley Zone, average number of spots on leaf ranged from 9 to 11, average size ranged from 15.56 to 32.45mm, exhibited two colours of spots of brown and orange brown on leaf. Isolate Is22\_Nag, Is23\_Nag, Is 26\_Mor and Is 27\_Jor developed 4, 2, 4, 2 numbers of concentric rings, respectively. In pods, the number of spots ranged from 5 to 7, size ranged from 9.78 to 45.56mm and exhibited dark brown and blackish brown colour and Isolate Is 7\_Nal developed 3 concentric rings. Not a single isolates developed any yellow halo around it.

In Upper Brahmaputra Valley Zone, average number of spots on leaf ranged from 16 to 105, average size ranged from 37.65 to 50.76mm, exhibited varied colours of spots like brown, dark brown and orange brown on leaf, most of the spots developed concentric rings and average number ranged from 4 to 10. While in pods the number of spots ranged from 6 to 27, size ranged from 12.56 to 32.34mm and exhibited dark brown and blackish brown colour. Isolate Is29\_Jor and Is35\_Dib developed yellow halo around it.

In Hill Zone, average no. of spots on leaf in Isolate Is 37\_Kar is 107 with 26.65mm size exhibiting brown colour, had average of 4 concentric rings and possessed yellow halo zones. While in case of pods, Isolate Is 36\_Tin had 20 blackish brown spots with average size of 16.76mm and Isolate Is 38\_NC exhibited 12 brown spots having average size of 12.56mm.

In Barak Valley Zone, Isolate Is 39\_Kar possessed 27 numbers of light brown spots/leaf having average size of 40.54mm surrounded by average of 4 concentric rings while in Isolate 40, average number of brown colored spots/leaf was 15 with 25.65mm size surrounded by average of 4 concentric rings.

Similar symptomatological findings was depicted by Goyal *et al.* (2013), where they found thirteen *Alternaria* isolates that showed variation in spot shape, colour, presence and absence of concentric rings and presence of yellow halo zones around the spots. Kaur *et al.* (2007) reported symptomatological variability among *A. brassicae* isolates considering qualitative characters, i.e., spot colour and yellow halo region while Quayyum *et al.* (2005), studied the same upon *Alternaria* isolates from American ginseng leaflets. Kolte *et al.* (1991) identified three *Alternaria* isolates- A, C, D on the basis of virulence, some spot characters viz., spot colour, presence or absence of concentric ring of the spot.

**Table 2**  
**Symptomatological observations of *Alternaria brassicae* isolates collected from different Agro climatic zones of Assam**

Isolates	Symptomatological observations of the <i>Alternaria brassicae</i> isolates						Seed			Presence of yellow halo		
	Av. Nos. of spots	Av. Size (mm)	Leaf Colour of the spots	Concentric Rings	Av. Nos. of rings	Av. Nos. of spots	Av. Size (mm)	Colour of the spots	Concentric rings		No of rings	
LBVZ												
Is 1_Kam	75	35.67	Light brown	+	10							+
Is 2_Kam	100	42.78	Brown	+	13							+
Is 3_Kam						50	13.79	Dark brown	-			-
Is 4_Dhu	15	26.29	Brown	+	9							+
Is 5_Dhu	72	50.05	Dark brown	+	11							+
Is 6_Nal	34	32.78	Brown	+	6							+
Is 7_Nal						12	45.67	Blackish brown	+		3	-
Is 8_Nal	53	33.67	Light brown	+	12							+
Is 9_Nal	40	43.44	Light brown	+	2							+
Is 10_Bar						12	8.55	Light brown	-			-
Is 11_Bar	47	40.12	Brown	+	3							-
Is 12_Bar	16	53.56	Orange brown	+	15							+
Is 13_Kok						13	5.67	Blackish brown	-			-
Is 14_Kok	100	35.67	Brown	+	7							-
NBPZ												
Is 15_Lak	78	29.67	Brown	+	4							+
Is 16_Lak	17	34.67	Orange brown	+	8							-
Is 17_Lak						13	17.78	Blackish brown	-			-
Is 18_Dhe	30	55.56	Brown	+	16							-
Is 19_Dhe	8	57.78	Brown	+	17							-
Is 20_Dar						5	12.78	Blackish brown	-			-
Is 21_Dar	17	35.65	Brown	+	13							-
CBZV												
Is 22_Nag	9	25.65	Orange brown	+	4							-
Is 23_Nag	11	26.67	Brown	+	2							-
Is 24_Nag						7	9.78	Dark brown	-			-
Is 25_Mor						5	10.45	Blackish brown	-			-
Is 26_Mor	9	32.45	Brown	+	4							-
Is 27_Jor						7	45.56	Dark brown	-			-
Is 28_Jor	10	15.56	Brown	+	2							-
UPVZ												
Is 29_Jor	105	50.76	Dark brown	+	10							+
Is 30_Jor						6	12.56	Dark brown	-			-
Is 31_Siv	16	45.67	Orange brown	+	7							-
Is 32_Siv	205	37.65	Brown	+	4							-
Is 33_Gol						5	12.67	Dark brown	-			-
Is 34_Gol												+
Is 35_Dib	96	45.67	Dark brown	+								-
HZ												
Is 36_Tin						20	16.76	Blackish brown	-			-
Is 37_Kar	107	26.65	Brown	+	4							+
Is 38_NC						12	12.56	Brown	-			-
BVZ												
Is 39_Kar	27	40.54	Light brown	+	4							-
Is 40_Cac	15	25.65	Brown	+	4							-

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